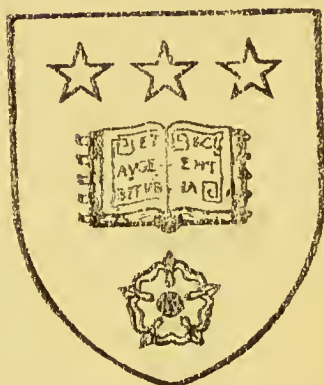


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PRACTICAL ANATOMY

VOLUME II

PRACTICAL ANATOMY

THE STUDENT'S DISSECTING MANUAL

BY

F. G. PARSONS, F.R.C.S. ENG.

Professor of Anatomy at St. Thomas's Hospital (University of London); Examiner in the University of Oxford, for the Conjoint Board in England and for the Society of Apothecaries; formerly Hunterian Professor and Aris and Gale Lecturer at the Royal College of Surgeons of England and Examiner in the Universities of Cambridge, Aberdeen, London, Birmingham, the National University of Ireland and for the Fellowship of the Royal College of Surgeons of England

AND

WILLIAM WRIGHT, M.B., D.Sc., F.R.C.S. ENG.

Professor of Anatomy at the London Hospital (University of London); Examiner at the Universities of London, Glasgow and Leeds, and for the Society of Apothecaries; formerly Hunterian Professor and Aris and Gale Lecturer at the Royal College of Surgeons of England and Examiner in the Universities of St. Andrew's, Liverpool, and Bristol, for the Fellowship of the Royal College of Surgeons of England and for the Conjoint Board in England

IN TWO VOLUMES

VOL. II

THE THORAX: ABDOMEN: PELVIS: UPPER EXTREMITY

SECOND IMPRESSION

LONDON
EDWARD ARNOLD & CO.

1923

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MADE AND PRINTED IN GREAT BRITAIN BY
THE DE LA MORE PRESS LTD., LONDON. W.

681741

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PRACTICAL ANATOMY

VOLUME II

THE THORAX

THE dissectors of the thorax cannot begin their work until the upper extremities have been removed, which seldom takes place until at least a fortnight after the dissection of the body has started.

During this period they should study the sternum, ribs, and vertebræ, as well as the articulated thorax, with great care, and should realise how small a portion of the upper part of the trunk is occupied by the thorax in the living person. Let them measure an adult man across the shoulders; the breadth may be some eighteen inches, but of this only four inches represent the upper aperture of the thorax.

The term *Thorax* is applied to that portion of the trunk which is protected anteriorly by a breastplate ($\theta\acute{o}\rho\alpha\chi$). It has the shape of a barrel flattened along its anterior and posterior aspects. Its greatest transverse diameter passes through the eighth costal arches.

During life its diameters and shape are constantly changing, respiration and circulation being thereby aided. The student should observe that by laying his hands on different parts of his chest all diameters will be shown to increase during inspiration and to decrease during expiration. He may further note that during inspiration the vertebral column in the thoracic region is straightened and moves backwards, that the sternum is carried upwards and for-

wards, that whereas the upper ribs move upwards and the lower ribs outwards, the last rib remains immovable, that the infracostal angle is widened, and that in easy inspiration the ventral abdominal wall moves forwards, whereas in deep inspiration it is retracted.

On examining the thorax of an articulated skeleton, the student will see that the posterior wall is formed by a narrow column of twelve vertebræ, the bodies of which increase in size from above downwards in accordance with the greater weight they have to support, that the anterior wall is constituted by the sternum, and that on the anterior surface of this bone, at the level of the second costal cartilages, a transverse ridge can be felt, called the *angle of Louis* [Angulus sterni]. This ridge is on the same horizontal plane as the lower surface of the body of the fourth thoracic vertebra. It will also be seen that the lateral walls are represented by twelve pairs of rib arches, all of which articulate behind with the vertebral column, but only the upper seven reach the sternum. The eighth, ninth, and tenth arches are connected anteriorly with each other, and through the eighth with the seventh. The last two arches end freely. While, therefore, the upper ten arches must move more or less together, the lower two are more independent.

It will further be seen that the costal arches are bony until they reach within a few inches of the sternum, where they become cartilaginous. The spaces between the arches, the intercostal spaces, are wider above than below, and each can be seen to become wider as it is traced forward; in other words, the costal arches tend to spread.

THE THORACIC WALL

First clean the superficial muscle, *the external intercostal*, of an intercostal space. One of the upper spaces, say, the fourth, will be preferable, on account of its width. In cleaning the muscle the *lateral cutaneous branch* of the corre-

sponding intercostal nerve should be sought, piercing the muscle about midway between the vertebral column and sternum. It should be carefully preserved.

The *external intercostal muscle* [M. intercostalis externus] will be found to reach backwards to the tuberosities of the ribs, and forwards to the junction of the ribs and cartilages; it is represented between the cartilages by a strong membrane—the *anterior intercostal membrane*. Notice that the muscle extends in an obliquely downward and forward direction from the lower border of one rib to the upper border of the rib below.

Detach the muscle from its lower attachment and reflect it upwards, preserving the lateral cutaneous nerve. By this procedure the *internal intercostal muscle* [M. intercostalis internus] will be exposed, and its fibres will be seen to be oblique in an opposite direction. The internal intercostal will be found to extend between the internal surfaces of adjacent ribs and to reach forwards almost to the sternum, backwards only to the angle of the ribs, beyond which it is, however, represented by a strong membrane—the *posterior intercostal membrane*—the thickened posterior edge of which is known as the *superior costo-transverse ligament* [lig. colli costæ].

This ligament passes from the lower margin of the transverse process of the vertebra above to the upper border of the neck of the rib below, and will be studied later (see p. 68).

Resect subperiosteally two inches of the third rib, just behind the mid-axillary line. In order to do this make a longitudinal cut through the periosteum for two inches along the outer surface of the rib, followed by a transverse cut at either end; then with a periosteal elevator or blunt knife raise the periosteum from the bone, injuring the former as little as possible. When the two inches of rib have been made bare on both surfaces and both borders, cut it away with the bone forceps. This resection is necessary in order to display

the *intercostal vessels and nerves* satisfactorily, since the outer lip of the subcostal groove overlaps and hides them. The lateral cutaneous nerve will act as a guide if need be. Notice that the vein, artery, and nerve are in this order from above downwards, though in well-injected subjects a second very small *collateral intercostal artery* may be found in the lower part of the space.

Traced forwards, these structures will be seen to sink into

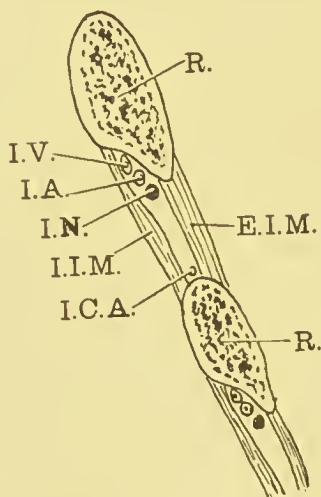


FIG. 190.—VERTICAL SECTION THROUGH TWO RIBS
AND AN INTERCOSTAL SPACE.

R. Rib. *E.I.M.* External Intercostal Muscle. *I.I.M.* Internal Intercostal Muscle. *I.V.* Intercostal Vein. *I.A.* Intercostal Artery. *I.N.* Intercostal Nerve. *I.C.A.* Intercostal Collateral Artery.

the substance of the internal intercostal muscle, the vessels passing to anastomose with branches of the internal mammary, which will be seen later.

Remove the external and internal intercostal muscles from the anterior inch or two of the upper seven intercostal spaces on the right side, taking care not to damage the underlying structures. Running parallel with the lateral border of the sternum and half an inch from it, the *internal mammary vessels* [*A. mamma interna*] will be seen.

Behind these vessels the museular fibres of the triangularis sterni musele will be seen passing upwards and outwards. A better view of it will be obtained later.

THE PLEURAL CAVITIES [CAVA PLEURÆ]

The PLEURAL SACS are two large serous cavities situated one on either side in the lateral portion of the thorax, and invaginated on their medial aspect by the lungs. As they are very subject to disease, it is a matter of great importance to the student that he should know the extent and relations of the sacs.

Remove three or four inches of the mid portions of the 6th, 7th, and 8th ribs on the left side, thus exposing the parietal pleura or outer layer of the delicate secreting membrane which surrounds the lungs. This should then be incised, so that the hand can be passed into the pleural sac. Explore the cavity by passing the hand upwards into the neck, and note its relation to the clavicle, subclavian vessels, and other structures there. It is a wise precaution to wrap two or three turns of a bandage round the wrist before doing this, in order to avoid scratches by the cut ends of the ribs. Next let the hand sweep downwards and inwards in front of the lung and behind the sternum, and then outwards and backwards along the attachment of the diaphragm. The lung should then be pulled a little forward, allowing the hand to be passed behind, and so the posterior portion of the sac can be explored. Through the aperture made in the chest wall the student should endeavour to see as much as possible of the lung and of the pleural cavity. He will thus find that the pleural sac reaches into the neck for about an inch above the clavicle, that above the level of the second costal cartilages the two sacs are separated by a V-shaped interval, the limit of the pleura passing behind the sterno-clavicular joint, that the sac reaches as low in the mammary line as the 8th, in the mid-axillary as the 10th, and beside the vertebral column as

the 12th rib, or in many cases even below that rib. The remembrance of this last fact is of practical importance, for in operations upon the kidney it is possible, by beginning the incision too high, to open inadvertently the pleural sac.

Ventrally it will be felt that the left pleural sac reaches the mid line between the 2nd and 4th ribs, but that below

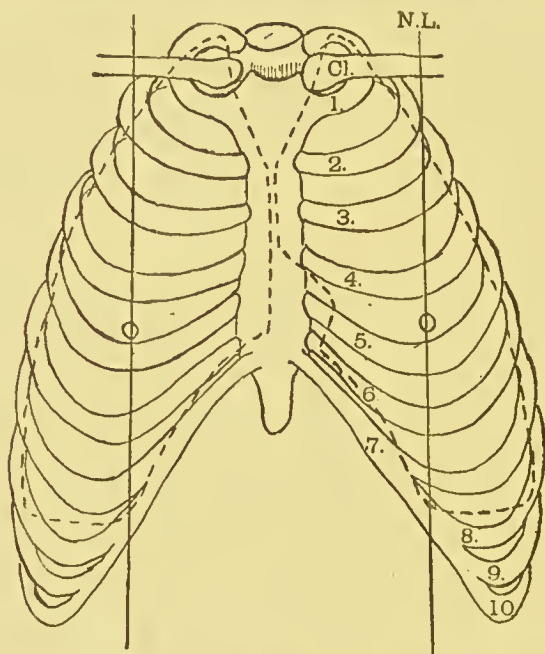


FIG. 191.—DIAGRAM TO SHOW THE RELATIONS OF THE PLEURAL SACS TO THE RIBS.

Cl. Clavicle. *N.L.* Nipple Line.

this it is usually pushed to the left by the heart and pericardium to a small extent.

In the old subjects, many of whom have suffered from chronic bronchitis, usually found in our dissecting-rooms, the left pleura often reaches the mid-ventral line from the second to the sixth rib levels, as it always does, on the right side.

Again, if the hand be passed round the lung until the

root of the organ is felt, it will be found that a thin fold of pleura (*ligamentum latum*) descends from the lower aspect of the root, binding the medial surface of the lung to the parietal pleura covering the lateral wall of the pericardium.

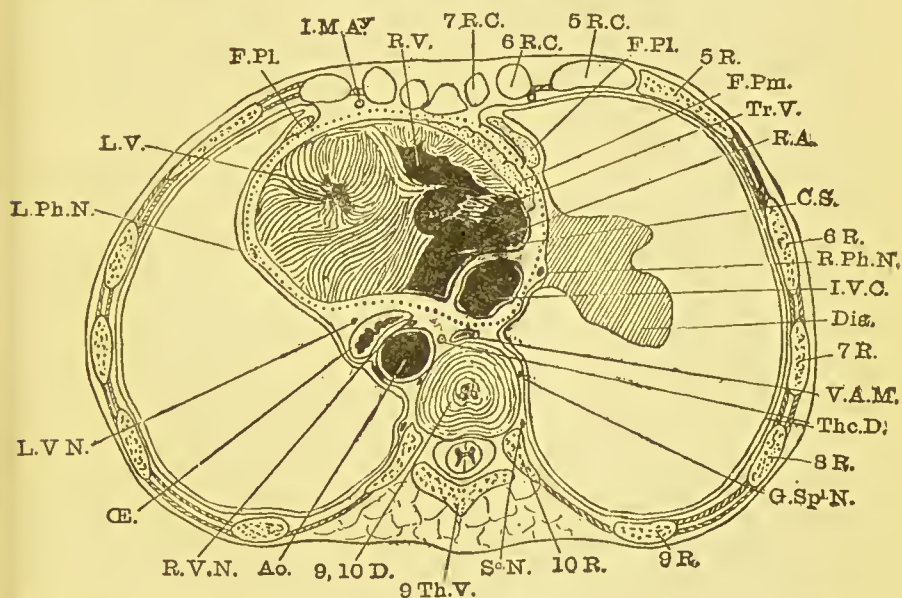


FIG. 192.—SECTION THROUGH THE DISC BETWEEN THE NINTH AND TENTH THORACIC VERTEBRÆ BEHIND AND XIPHISTERNAL JUNCTION IN FRONT. (TRACED FROM NATURE WITH A DIAGRAPH.)

R. stands for Rib and *R.C.* for Rib Cartilage. *I.M.A.*, Internal Mammary Artery. *F.Pl.* Fatty Fold in Pleura. *F.Pm.* Fat in the Visceral Pericardium. *Tr.V.* Marginal Cusp of the Tricuspid Valve. *R.A.* Right Auricle. *C.S.* Coronary Valve. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *R.V.* Right Ventricle. *L.V.* Left Ventricle. *R.V.N.* Right Vagus Nerve. *L.V.N.* Left Vagus. *I.V.C.* Inferior Vena Cava. *Dia.* Right Cupola of Diaphragm exposed. *V.A.M.* Vena Azygos Major. *Thc.D.* Thoracic Duct. *C.E.* Cesophagus. *Ao.* Descending Thoracic Aorta. *G.Sp.N.* Great Splanchnic Nerve. *S.N.* Sympathetic Nerve. The Parietal Pericardium is represented by a dotted line.

Three narrow cleft-like spaces in connection with the pleura should be now explored—the *pericardio-phrenic*, the *pericardio-sternal*, and the *costo-phrenic*. Their names sufficiently indicate their positions. The first lies between the

pericardium and diaphragm, and usually has in connection with it subserous accumulations of fat, the so-called *plivæ adiposæ* (see Fig. 192, F.Pl.). The two latter are narrow recesses, only partially occupied in the dead body by the thin anterior and inferior margins of the lungs respectively. They lie, the one between the pericardium and sternum, the other between the diaphragm and the lower lateral part of the thoracic wall.

As they are unoccupied by the lung in normal respiration, the two layers of parietal pleura are in immediate contact in these situations.

The right pleural sac corresponds in every way with that of the left side, except that it reaches the middle line of the sternum as low as the 6th costal cartilage instead of leaving it at the 4th. To obtain a clearer view of the extent and position of the pleural sacs the following dissection should be made. Make two transverse saw-cuts through the sternum, one just below the level of the 1st costal cartilages, the other just below the level of the 6th. Next divide the sternum longitudinally with the saw in the middle line joining the two transverse cuts. With a pair of bone forceps divide on both sides, the 2nd to the 6th ribs inclusive, near their angles, but be careful not to sever the intervening intercostal muscles, or to incise the parietal pleura. As a result of this procedure it will now be possible to turn a large part of the thoracic parietes outward, or, in other words, open the thorax as a book is opened. It is of the greatest service in studying the important subject of cardiac topography to be able to so open or close the whole or the half of the thorax at will. On separating the two halves of the longitudinally-divided sternum a view will be obtained of the outside of the pleural sacs. Pass a forefinger up and down between the parietal pleura and the wall of the thorax proper, in this way stripping off the parietal pleura as a thin membrane. In many cases this procedure is not practicable owing to inflammatory adhesions, but it should

always be attempted. Before the walls of the thorax can be turned outward it will be necessary to divide the *Internal Mammary Vessels* and the *Triangularis Sterni muscle* [M. thoracis transversus]. The vessels run parallel to and half an inch from the lateral border of the sternum. They should be divided at the level of the upper and lower transverse saw-cuts. The triangularis sterni will be divided at the lower level only. On turning the wall now aside the last-mentioned muscle will be seen to spring from the back of the gladiolus, ensiform cartilage, 5th, 6th, and 7th rib cartilages, and to pass upwards and outwards to the 2nd, 3rd, 4th, 5th, and 6th costal arches at the junction of the rib and cartilage. The internal mammary vessels lie superficial to the muscle in part of their course. On the deep surface of the parietes a good view will be obtained of the internal intercostal muscles, while posterior to the angles of the ribs the fibres of the *subcostal muscles* may be distinguished. Although the direction of these subcostal fibres is the same as that of the fibres of the internal intercostal muscles, they are on a deeper plane and are longer, passing in many cases over a rib in their course from the internal surface of one rib to the internal surface of another. They are supplied by branches of the intercostal nerves (see Fig. 210). The triangularis sterni muscle now exposed on the reflected wall should be carefully cleaned, and its attachments, already stated, should be confirmed. An attempt should be made to trace into its substance nerve twigs from the neighbouring intercostal nerves, which are seen as they near the sternum passing forwards deep to the internal intercostal muscles and superficial to the triangularis sterni and internal mammary vessels. The nerves enter the muscle on its superficial surface.

The portion of the internal mammary artery extending from the 2nd to the 6th costal cartilages should also be examined at this stage. It will be seen to be accompanied by a pair of veins and to furnish branches inwards to the

sternum, outwards to the intercostal spaces (*anterior intercostal arteries*), forwards (*perforating branches*) to the mammary gland, pectoralis major muscle and skin of the chest,

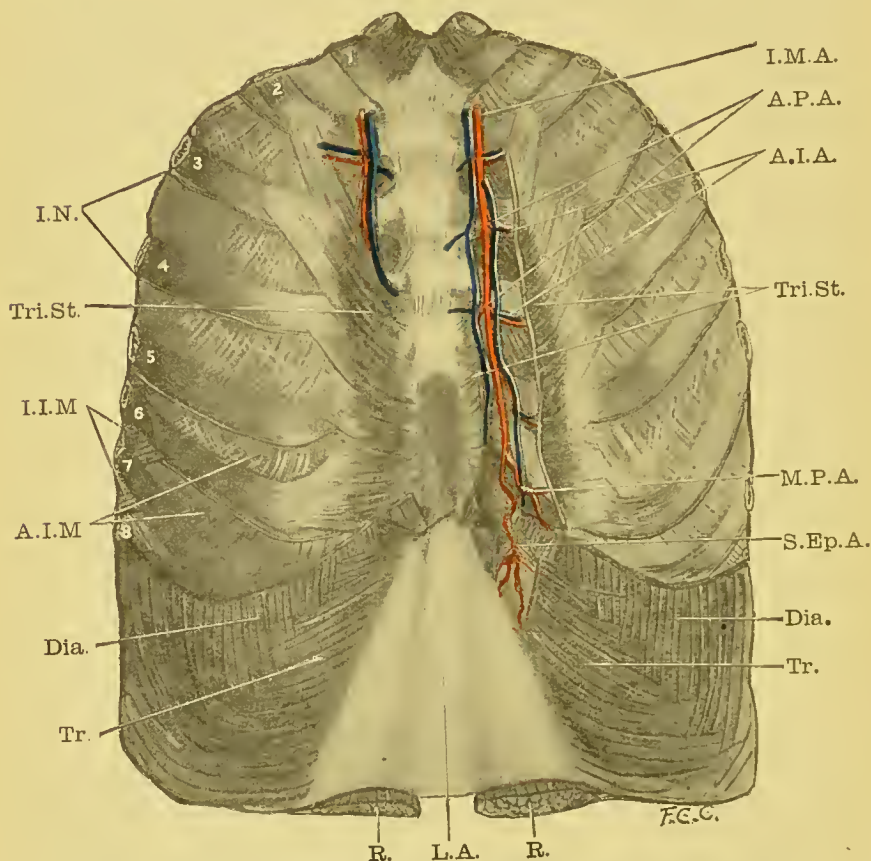


FIG. 193.—THE ANTERIOR THORACIC WALL REMOVED AND LOOKED AT FROM BEHIND.

I.M.A. Internal Mammary Artery. *A.P.A.* Anterior Perforating Arteries. *A.I.A.* Anterior Intercostal Arteries. *Tri.St.* Triangularis Sterni Muscle. *I.N.* Intercostal Nerve. *I.I.M.* Internal Intercostal Muscles. *M.P.A.* Musculo-phrenic Artery. *S.Ep.A.* Superior Epigastric Artery. *Dia.* Diaphragm. *Tr.* Transversalis. *R.* Rectus. *L.A.* Linea Alba.

and backwards to the pleura. That portion of the artery which lies behind the fifth space on the left side is of practical importance, for the surgeon usually chooses this space in

tapping the pericardium. He enters the trocar and cannula an inch and a half from the lateral border of the sternum, in order to avoid the internal mammary vessels.

Now slit open both pleural cavities, pass the hand behind the lung and explore the posterior portion of the sac, noting the marked contrast which exists between the sharp anterior border and the rounded posterior border of the lung. A similar sharp contrast obtains between the rounded conical apex of the lung and the broad excavated base. The apex is, moreover, free in the sense that the hand can be passed all round it, whereas the base is attached by the *ligamentum latum pulmonis* to that portion of the parietal pleura which covers the lateral surface of the pericardium. The base of the lung should now be lifted up, when the parietal pleura will be seen covering the dome of a large muscular partition, the *diaphragm* [diaphragma], which separates the thoracic and abdominal cavities, and passing down in the angular interval between the diaphragm and the lower costal arches. Two matters of considerable practical importance must now be mentioned. In various diseases fluid collects in the pleural cavity or under the diaphragm, and surgical measures have to be taken to evacuate it. Tapping the pleural cavity or chest is usually performed by plunging a trocar and cannula through the 5th interspace in or slightly in front of the mid-axillary line. The student may with advantage perform this operation, substituting if need be his scalpel for the trocar and cannula.

Although the site for tapping a sub-diaphragmatic abscess depends upon circumstances, a common situation is in the 8th and 9th spaces in the mid-axillary line. Resect a portion of the 8th or 9th rib in this line on the right side, thereby exposing the parietal pleura. Pass the forefinger down between the parietes proper and this parietal layer to the level of the 10th rib, when the diaphragm will be reached. The student can now understand how by incising the diaphragm the surgeon can give exit to any fluid which has

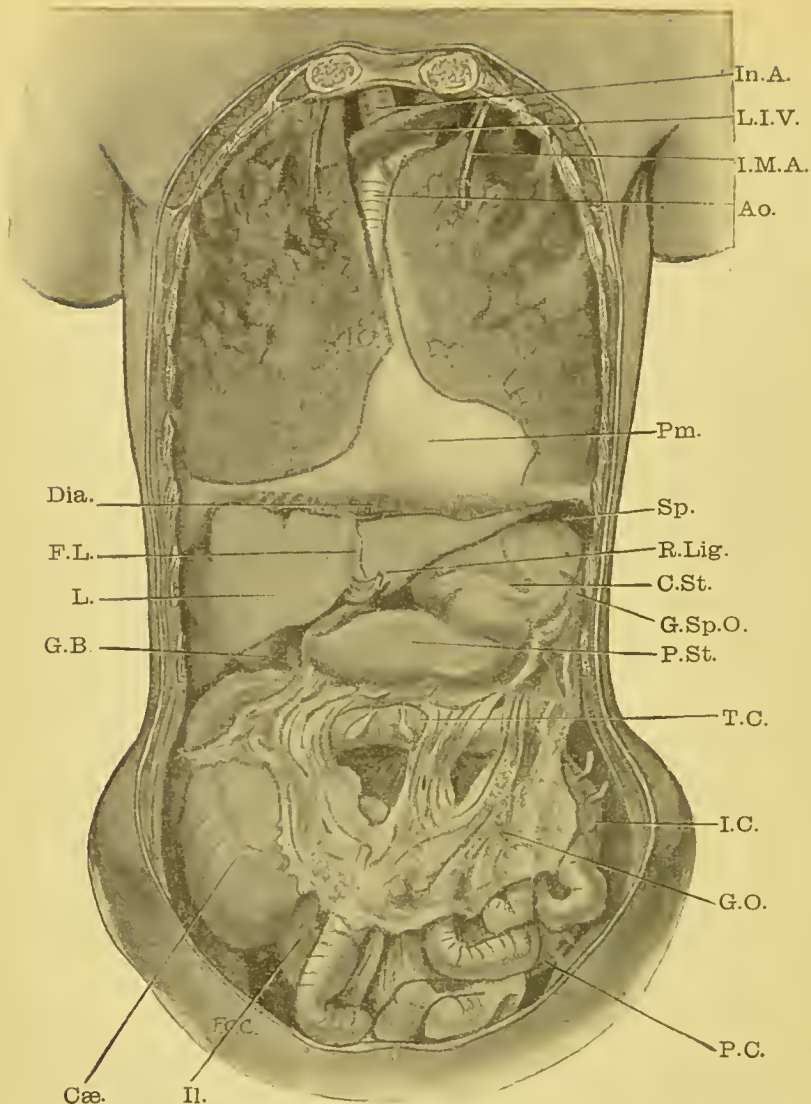


FIG. 194.—HARDENED VISCERA UNDISTURBED AFTER REMOVAL OF THE FRONT OF THE BODY WALL.

In.A. Innominate Artery. *L.I.V.* Left Innominate Vein. *I.M.A.* Internal Mammmary Artery. *Ao.* Aorta. *Pm.* Pericardium. *Dia.* Diaphragm. *F.L.* Falciform Ligament. *L.* Liver. *G.B.* Gall Bladder. *Sp.* Spleen. *R.Lig.* Round Ligament. *C.St.* Cardiac Portion of Stomach. *G.Sp.O.* Gastro-splenic Omentum. *P.St.* Pyloric Portion of Stomach. *T.C.* Transverse Colon. *I.C.* Iliac Colon. *G.O.* Great Omentum (two cuts have been made in it to show the Transverse Colon). *P.C.* Pelvic Colon. *Cæ.* Cæcum. *Il.* Ileum.

accumulated underneath it in the abdominal cavity (see Fig. 194).

The PERICARDIUM should now be studied before the lungs are displaced. It will be seen as a fibrous bag lying in the median plane behind the gladiolus and between the two pleural sacs. It should here be noted that it is enveloped by the pleural sacs, which separate it from the anterior thoracic wall, except over a narrow triangular area limited to the right by the median line from the 4th to the 6th costal cartilages below by a horizontal line extending for 1 to 2 inches to the left from the median line at the level of the 6th costal cartilages, and to the left by an oblique line running downwards and outwards, joining the free extremities of these lines. The student will now understand that in tapping the pericardium through the 5th space on the left side the surgeon may, if he introduces the trocar too near the sternum, injure the internal mammary vessels, while, if too far from the sternum, he may penetrate the pleural cavity. It should be remembered, however, that the pericardium is always distended in those cases in which tapping is necessary, and, further, that in such conditions the left pleural sac is pushed to a considerable distance from the middle line. With the forefinger strip the pleura from the pericardium, when the latter will be seen to have the shape of a truncated cone with its base resting upon, and inseparably fused with, the diaphragm, while its blunt apex reaches as high as the 2nd costal cartilages.

By replacing a portion of the thoracic parietes note that the pericardium reaches as high as the 2nd costal cartilages and as low as the 6th, that to the right it extends for half an inch or so beyond the lateral margin of the sternum, while below and to the left it reaches to a point $3\frac{1}{2}$ inches from the middle line in the 5th intercostal space. Pick up the anterior wall of the pericardium with a pair of forceps, and with scalpel or scissors make a median vertical incision through it from apex to base. The pericardial sac, which

from the outside seemed to be a fibrous bag, is now seen to be lined on the inside by a thin glistening serous membrane, the parietal layer of serous pericardium. A similar membrane, the visceral layer of serous pericardium, covers the

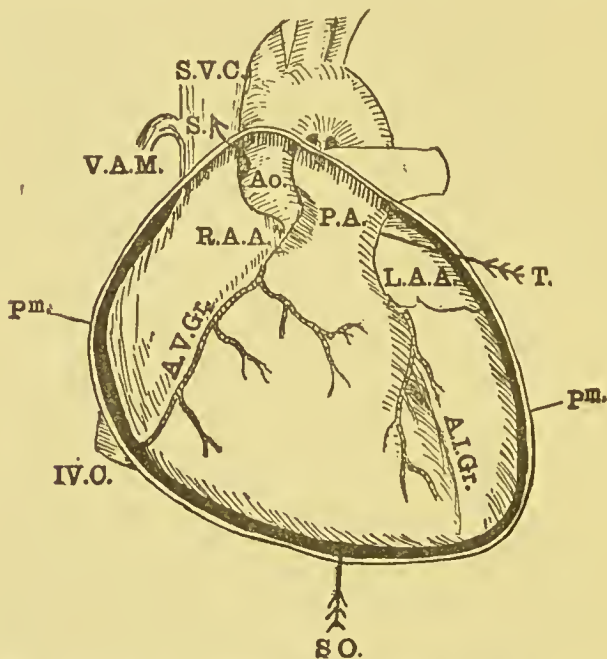


FIG. 195.—VIEW OF A HEART FROM WHICH THE FRONT OF THE PARIETAL PERICARDIUM HAS BEEN CUT AWAY.

S.V.C. Superior Vena Cava. *V.A.M.* Vena-azygos Major. *Ao.* Aorta. *P.A.* Pulmonary Artery. *S., T.* Arrow passed through the Sinus Transversus. *R.A.A.* Right Auricular Appendage. *L.A.A.* Left Auricular Appendage. *Pm.* Pericardium. *I.V.C.* Inferior Vena Cava. *A.V.Gr.* Anterior Auriculo-ventricular Groove. *A.I.Gr.* Anterior Interventricular Groove. *S.O.* Arrow passed into the Sinus Obliquus.

heart. These two layers are continuous with each other at the top of the pericardium as well as posteriorly where the great veins lie. The heart will be seen to be formed of a fixed postero-superior portion, the auricles, and a free antero-inferior portion, the ventricles. A groove, occupied by a variable amount of fat, represents on the surface of the

heart the line of separation; it is called in consequence the *auriculo-ventricular groove* [sulcus coronarius]. Passing downwards and to the left from this groove another similar groove will be seen dividing the ventricular portion of the heart into, as seen from the front, a larger right and a smaller left portion; this groove corresponds to a septum between the two ventricles, and is known as the *anterior interventricular groove* [sulcus longitudinalis anterior]. The division of the auricular portion of the heart into right and left com-

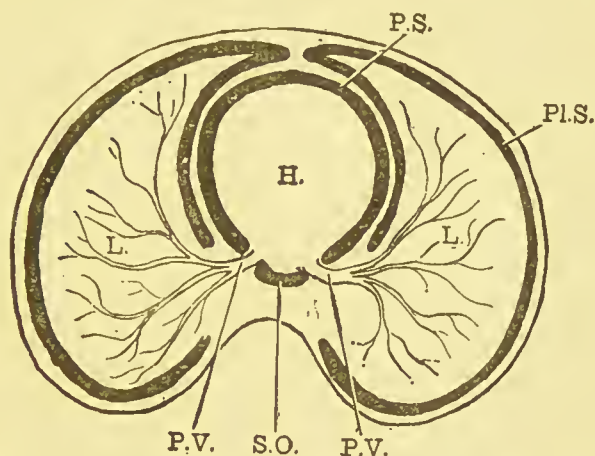


FIG. 196.—DIAGRAMMATIC SCHEME OF THE PERICARDIAL AND PLEURAL SACS.

P.S. Pericardial Sac. *Pl.S.* Pleural Sac. *H.* Heart. *L.* Lung.
P.V. Pulmonary Veins. *S.O.* Sinus Obliquus Pericardii.

partments is not at present evident, since the only part of the left auricle which can be seen is the tip of the auricular appendix (see Fig. 195).

Opening into the right side of the auricular portion will be seen two large vessels, one of which passes downwards, the other upwards; they are the superior and inferior venæ cavæ. These can be made more evident by gently pulling the heart to the left. They are usually full of blood clot. If the free portion of the heart be now lifted upwards, a number of large vessels will be seen opening into the left

part of the auricular portion; they are the pulmonary veins, and are usually two on each side. A distinct recess is situated between the pulmonary veins of either side; it is termed the *sinus obliquus pericardii*, and should be explored by the finger; it is closed above. Lying in front of the auricles are two large trunks passing upwards from the right and left ventricles; they are the *pulmonary artery* [A. pulmonalis], and the *ascending aorta* [A. ascendens]. The former, which is the more superficial, passes upwards and to the left, the latter upwards and to the right. These two large vessels will be seen to lie within the concavity of the crescent-shaped auricular portion, the two horns of which project forwards as ear-shaped appendages, the right and left auricular appendices. If the pulmonary artery and the aorta be now taken together between the fingers and thumb, it will be found that they can be lifted up, and a finger may be hooked behind them lying in a transverse passage known as the *sinus transversus pericardii*. This sinus opens at either end into the general pericardial cavity (see Fig. 195). Its presence is attributable to the fact that the two vessels are surrounded by a common tube of serous pericardium. Note that the posterior wall of the sinus transversus is formed by the two auricles.

THE HEART

The right and left borders of the ventricular portion of the heart are in marked contrast, the former being sharp and horizontal—the *margo acutus*—the latter rounded and oblique—the *margo obtusus*. They meet at the apex of the heart. Along the right border particularly there is usually to be seen an accumulation of subserous fat (see Fig. 192, F.P.m.). In studying the relationships obtaining between the different portions of the heart, it is of advantage to note that the long axis of the heart from base to apex is obliquely downwards, forwards, and to the left, in consequence of which

the right side of the heart is slightly lower than the left side. Further, the right portion is more anterior than the left portion, as though the heart had been rotated around its long axis to the left. The right auricle thus lies in front of the left auricle as well as to the right, and the *anterior interventricular groove* is nearer the left border than the right. The compartments of the heart should next be studied, while the viscus remains *in situ*. It is most convenient to study them in the order in which they are traversed by the main blood stream, beginning with the right auricle.

The RIGHT AURICLE [Atrium dextrum]. — Pull the heart to the left, and so obtain a good view of the right side of the auricular portion of the heart. Identify the *Superior* and *Inferior Venæ Cavae*. Immediately in front of these a crescentic line or sulcus will in many cases be seen extending the whole length of the right auricle; it is called the *sulcus terminalis*, and is of interest in that it is the remains of the original constriction between the sinus venosus and right auricle proper. The sinus venosus is represented in the human heart by that portion of the right auricle which lies behind the sulcus and receives the two large venæ cavae. It will be seen later that there is a ridge called the *crista terminalis*, on the inner wall of the auricle, which corresponds to the sulcus on the outside. The right auricle is best opened, as in the accompanying diagram (Fig. 197), by one incision passing from the opening of the superior vena cava to the tip of the auricular appendage, and another from this latter point parallel to and just above the auriculo-ventricular sulcus; the flap may then be turned outwards, and does not obscure any other part of the heart. The *crista terminalis* can be readily distinguished running along the right side of the anterior reflected wall from in front of the opening of the superior vena cava to in front of the opening of the inferior. The clot in the right auricle should now be carefully removed, when, if the cavity is sponged out, a good view of the interior will be obtained. It

will be at once seen that the cavity is divisible into two parts, the wall of one of which is smooth, while that of the other is thrown into a number of more or less parallel ridges which pass forwards from the crista terminalis like the teeth from

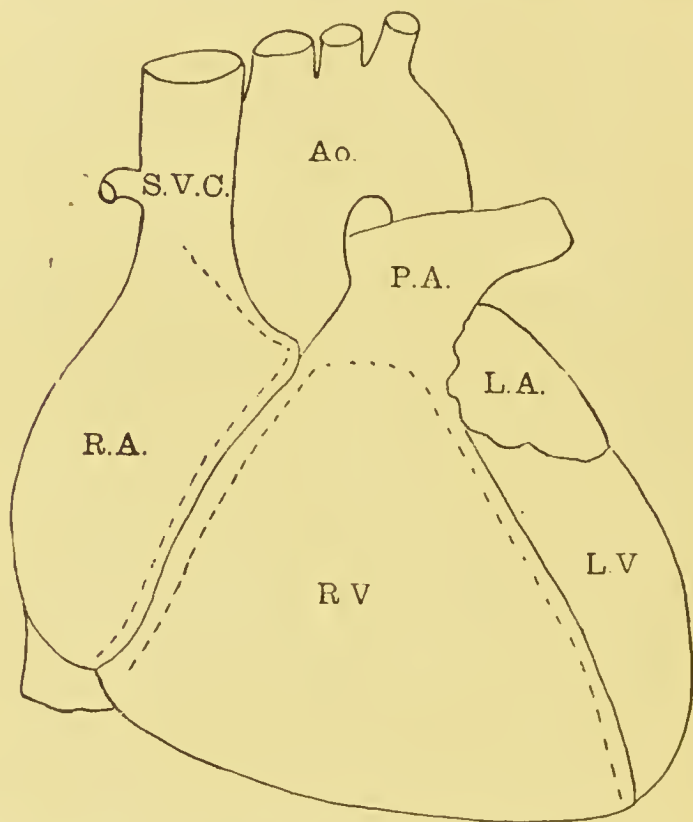


FIG. 197.—DIAGRAM TO SHOW THE INCISIONS ADVISED FOR OPENING THE CAVITIES OF THE RIGHT SIDE OF THE HEART.

S.V.C. Superior Vena Cava. *R.A.* Right Auricle. *Ao.* Aorta. *P.A.* Pulmonary Artery. *R.V.* Right Ventricle. *L.V.* Left Ventricle. *L.A.* Left Auricular Appendage.

the back of a comb; the ridges are therefore known as *musculi pectinati*. There is thus shown to be a distinct structural difference between the sinus venosus and auricle proper. Now examine the left or posterior wall of the

auricle, which, it will be understood, is formed by the septum auricularum. Near its centre will be seen a shallow oval depression, bounded by a thickened ridge everywhere

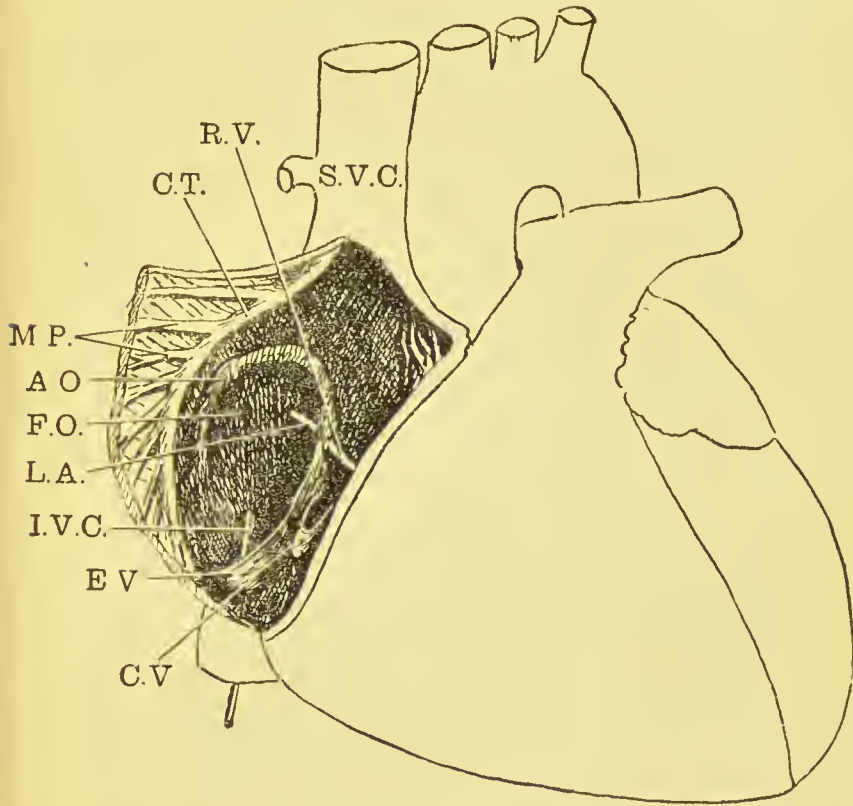


FIG. 198.—RIGHT AURICLE OPENED FROM IN-FRONT.

S.V.C. Superior Vena Cava. *R.V.* Rod passing through the Right Auriculo-ventricular Opening. *C.T.* Crista Terminalis. *M.P.* Musculi Pectinati. *A.O.* Annulus Ovalis. *F.O.* Fossa Ovalis. *L.A.* Rod passed through a Valvular Opening, which is often present, into the Left Auricle. *I.V.C.* Rod passed into the Inferior Vena Cava. *E.V.* Eustachian Valve. *C.V.* Coronary Valve.

except below. The depression is the *fossa ovalis*, the ridge the *annulus ovalis* [limbus fossæ ovalis]. From the anterior horn of this annulus a thin crescentic membrane will be seen passing forward and to the right to reach the anterior wall

of the auricle, immediately in front of the opening of the inferior vena cava. It is known as the *valve of Eustachius* [valvula venæ cavæ]. It directed the blood in the fœtus from the inferior vena cava to the fossa ovalis, which at that stage was patent and known as the *foramen ovale*. In front of the valve is a large opening into the right ventricle admitting, under normal circumstances, three fingers; it is the *right auriculo-ventricular aperture* through which in the fœtus passed the blood from the superior vena cava, the valve of Eustachius thus separating the two streams. The position of the right auriculo-ventricular aperture, in terms of the anterior thoracic wall, should now be studied by replacing the right part of the reflected thoracic parietes. It will be seen to lie obliquely behind the sternum, close to the middle line, and to extend from the level of the 4th left costal cartilage to the level of the 6th right (see Fig. 201, p. 26).

Below the opening of the inferior vena cava look for that of the *coronary sinus*; it is guarded by a small pocket-like valve [valvula sinus coronarii], the opening of which points to the left.

In about 25 per cent. of all normal hearts a valvular opening will be found in the anterior part of the fossa ovalis leading into the left auricle; it is sometimes large enough to admit a good-sized quill.

The RIGHT VENTRICLE [Ventriculus dexter].—The Right Ventricle should next be studied. Notice that it forms the whole of the right margin of the ventricular portion of the heart, and that, as seen from the front, it is prolonged upwards into a conical portion, the *infundibulum*, which in turn is continued into the pulmonary artery. Pass the forefinger through the right auriculo-ventricular aperture from the right auricle to the right ventricle, and with a sharp scalpel divide the wall of the ventricle upon it, making the incision run parallel to and just below the auriculo-ventricular groove. From the left extremity of this incision cut parallel to the

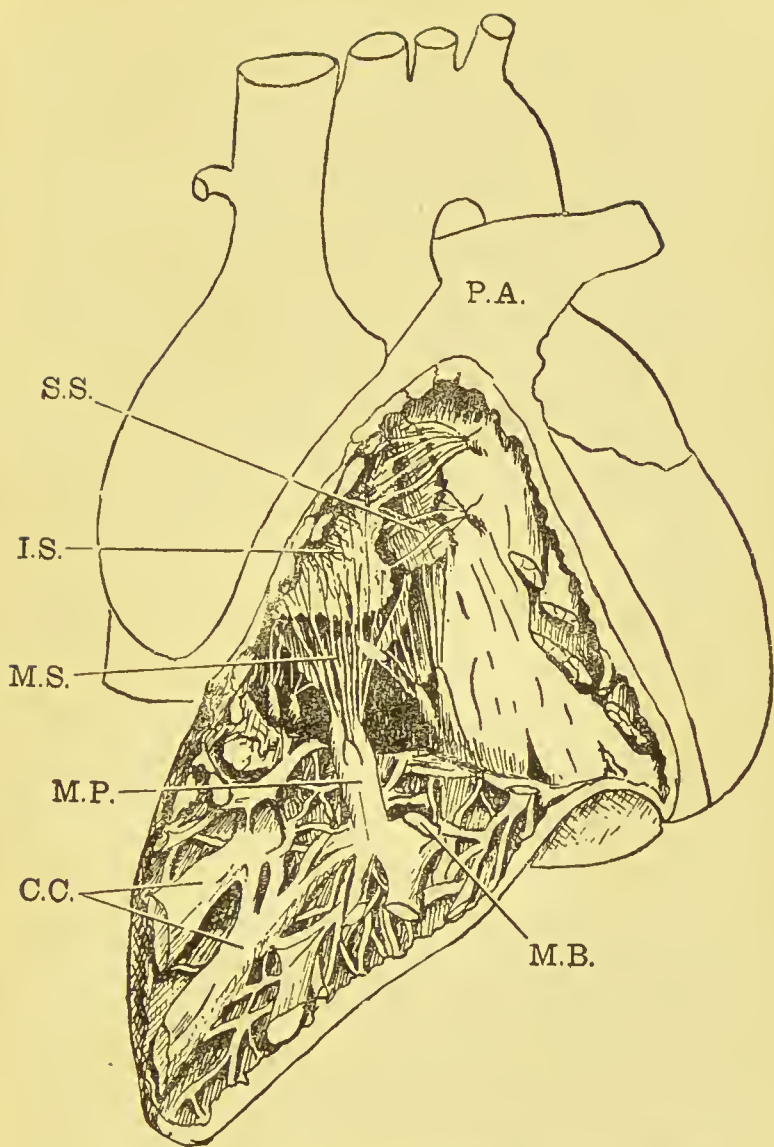


FIG. 199.—RIGHT VENTRICLE OPENED FROM IN FRONT.

P.A. Pulmonary Artery. *S.S.* Septal Cusp of Tricuspid Valvo. *I.S.* Infundibular Cusp of Tricuspid Valve. *M.S.* Marginal Cusp of Tricuspid Valve. *M.P.* Anterior Group of Musculi Papillares. *M.B.* Moderator Band (cut). *C.C.* Columnæ Carneæ.

interventricular sulcus towards the apex. On turning the triangular flap downwards a good view will be obtained of the interior of the cavity (see Fig. 197). The surface is marked by a large number of muscular columns, the *columnæ carneæ* [trabeculae carneæ], some detached, except at their extremities, from adjoining parts, others semi-detached. Among these columnæ carneæ are a number of conical eminences, the *musculi papillares*, the largest of which are to be found on the anterior wall. From the apices and sides of these eminences pass a number of tendinous cords—the *chordæ tendineæ*—which are traceable to delicate membranous folds dependent from the margin of the auriculo-ventricular aperture. These folds are the cusps of the *right auriculo-ventricular valve*. The cusps are, normally, three in number—one anterior, one to the left, one to the right—and are known respectively, because of their positions, as *infundibular*, *septal*, and *marginal*. In some cases, however, two of these cusps are united, usually the infundibular and the marginal, while in other cases all three are continuous. When the three cusps are present it is often possible to make out small accessory cusps between them. The valve, because of the number of its cusps, is often termed the *tricuspid valve* [valvula tricuspidalis], while the right auriculo-ventricular aperture which it guards is, because of the association, styled the *tricuspid aperture*. Note that the chordæ tendineæ are attached to the margins and ventricular surfaces of the cusps and not to the auricular surfaces. Now examine the anterior musculi papillares, when there will probably be observed a strong muscular bundle which passes from the base of one of the largest of them across the cavity of the ventricle to the septum. The bundle is known as the *moderator band*, and is of interest in that it contains a definite extension of the *auriculo-ventricular muscle bundle*, which connects the musculature of the auricle with that of the ventricle. It is only in a fresh heart that this bundle can be seen. It is most easily observed in the sheep's heart,

and the most reliable guide to it is the moderator band. If the septum of the ventricles is now sponged and examined in its upper and fore portion, a part will be seen from which muscular fibres are almost or entirely absent, *pars membranacea septi*. It is of importance in that it is the last portion of the septum to be formed, and is the portion missing in most cases of congenital deficiency of the septum. It will be more distinctly seen later.

The LEFT AURICLE [Atrium sinistrum].—Only the appendix of the left auricle is seen from the front. A glimpse of the remainder of this chamber may be obtained by lifting the apex of the heart upwards and examining the posterior surface of the organ. The posterior surface of the left auricle is quadrilateral, and receives the two pulmonary veins of either side.

In a few cases the cavity may be opened and examined in this position, and, if possible, it is well that it should be done while the relative position of the parts is undisturbed. In most cases, however, enough light cannot be thrown into the sinus obliquus of the pericardium, in which the work is going on, to enable the dissector to make out details satisfactorily, and, when this is so, it is better to wait until the heart is removed before opening the left auricle at all.

The most useful incision is in the form of an inverted T, the vertical cut running up between the openings of the pulmonary veins of either side while the lower horizontal incision runs parallel to and just above the auriculo-ventricular sulcus, in which the *coronary sinus* will be found.

It is not advisable to slit open the veins, or their apertures will be difficult to find, and important landmarks thus lost. The lower incision should be continued to the left until the auricular appendage is laid open.

Clean the interior of clotted blood and injection, when the auricular wall will be seen to be quite smooth, except in the appendix where muscoli pectinati are present. In a fresh

heart the interior of the left auricle looks much whiter than that of any of the other chambers; this is due to the

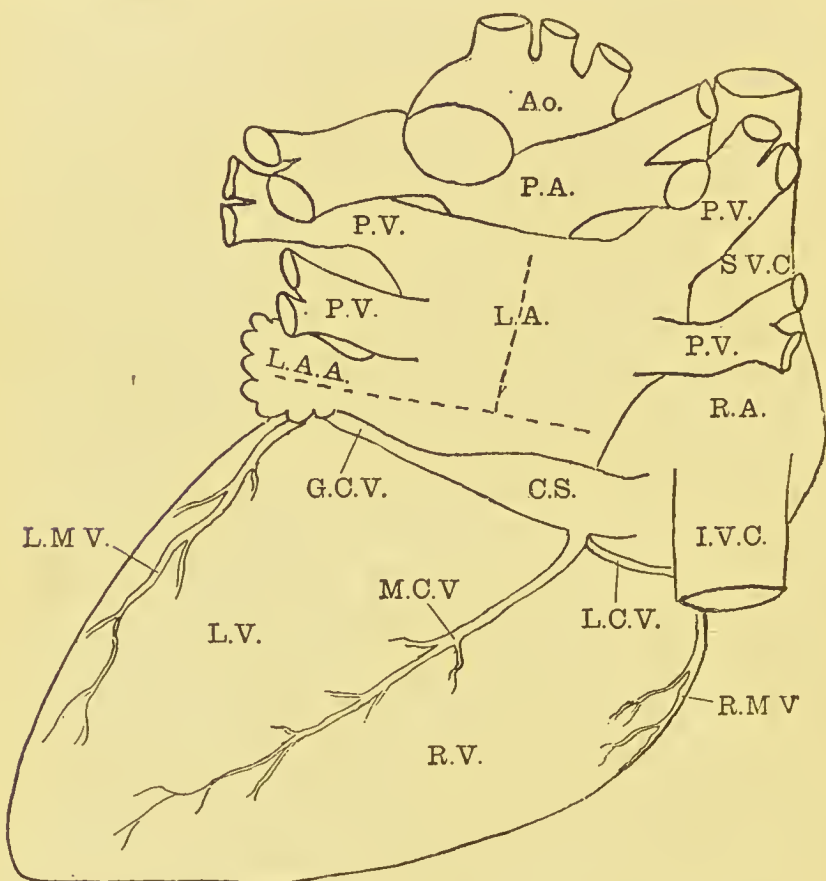


FIG. 200.—HEART FROM BEHIND TO SHOW THE METHOD OF OPENING THE LEFT AURICLE.

Ao. Aorta. *P.A.* Pulmonary Artery. *P.V.* Pulmonary Vein. *S.V.C.* Superior Vena Cava. *L.A.* Left Auricle. *L.A.A.* Left Auricular Appendage. *R.A.* Right Auricle. *I.V.C.* Inferior Vena Cava. *C.S.* Coronary Sinus. *G.C.V.* Great Cardiac Vein. *L.C.V.* Lesser Cardiac Vein. *M.C.V.* Middle Cardiac Vein. *L.M.V.* Left Marginal Vein. *R.M.V.* Right Marginal Vein. *L.V.* Left Ventricle. *R.V.* Right Ventricle.

much greater thickness of the endocardial lining, which can be stripped off easily with a pair of forceps in this chamber,

though it is very difficult indeed to do so in any of the others.

On the wall of the interauricular septum, which bounds the front of the auricle, is a faint indication of the fossa ovalis and to the left of this a depression something like the mark of a finger-nail. If this is carefully explored with a seeker, it may be found to communicate with the right auricle, as was noticed above.

The openings of the pulmonary veins, which are usually two in number on either side, are unguarded by valves. From the left auricle the blood passes by the *left auriculo-ventricular aperture* into the left ventricle. This aperture is smaller than the one on the right side, and only admits two fingers.

The LEFT VENTRICLE [Ventriculus sinister].—Take hold of the left ventricle between finger and thumb and transfix it with a long scalpel, entering close to the auriculo-ventricular groove immediately to the left of the interventricular groove. Cut downward parallel with the septum, so that the scalpel emerges just above the apex of the heart. The great thickness of the wall of the left ventricle will be at once observed. The wall is three times as thick as that of the right ventricle. The interior has a similar appearance to that on the opposite side, except that the columnæ carneæ and muscoli papillares are stronger. Hanging down from the margin of the left auriculo-ventricular aperture are two membranous folds, the *cusps of the left auriculo-ventricular valve*, which, from its resemblance in shape to a bishop's mitre, has received the name *mitral valve* [valvula bicuspidalis]. The chordæ tendineæ are related to the cusps of this valve in an exactly similar manner to that in which they are related to the cusps of the tricuspid valve. The pars membranacea septi will be again seen at the upper and fore part of the septum. Its thinness, in sharp contrast to the surrounding thickness of the rest of the septum, is well made out by passing the index finger into one ventricle and the thumb into

the other, and so rolling the pars membranacea between them.

Notice that the right cusp of the valve lies close to the aortic orifice, while the left is near the margo-obtusus of the

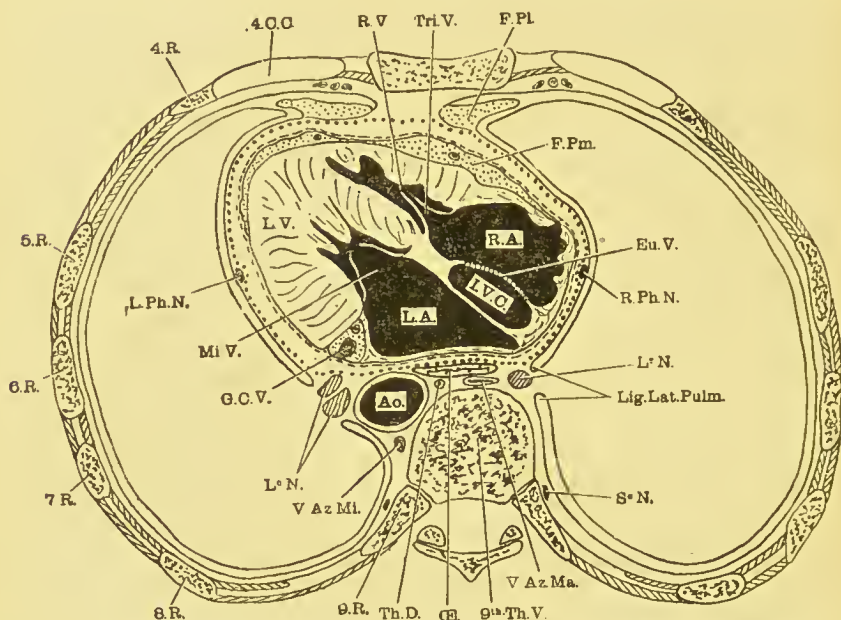


FIG. 201.—TRANSVERSE SECTION THROUGH THE THORAX AT THE LEVEL OF THE FOURTH COSTAL CARTILAGE.

R.V. Right Ventricle. *Tri.V.* Tricuspid Valve. *F.Pl.* Fatty Fold in the Pleura. *F.Pm.* Fat deep to the Visceral Layer of the Pericardium. *R.A.* Right Auricle. *L.A.* Left Auricle. *Eu.V.* Eustachian Valve. *I.V.C.* Inferior Vena Cava. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *Mi.V.* Mitral Valve. *G.C.V.* Great Cardiac Vein. *Lc.N.* Lymphatic Nodes. *Ao.* Descending Aorta. *V.Az.Mi.* Vena Azygos Minor. *Th.D.* Thoracic Duct. *E.* Œsophagus. *V.Az.Ma.* Vena Azygos Major. *Sc.N.* Sympathetic Nerve. *Lig.Lat.Pulm.* Ligamentum Latum Pulmonis.

heart. For these reasons the two cusps are spoken of as the *aortic* and *marginal* respectively (see Fig. 202).

A horizontal section of the thorax through the fourth costal cartilages shows all four cavities of the heart and their relations to surrounding parts (see Fig. 201).

The other contents of the pericardium should now be examined, the *pulmonary artery* and the *ascending aorta*. The former vessel begins where the infundibulum ends at the back of the third costal cartilage on the left side. It passes upwards and to the left for a little over an inch, lying between the right auricular appendix and the ascending aorta on the right side and the left auricular appendix on the left side. Behind, it is in relation to the left auricle, while in front it is in contact with the anterior wall of the pericardial sac.

The *ascending aorta* begins, as will be seen later, a little below and to the medial side of the pulmonary artery. It passes upwards and to the right, lying in front of the two auricles, with the appendix of the right auricle and the superior vena cava to the right and the pulmonary artery to the left. The infundibulum of the right ventricle is an anterior relation below. Pass the finger from the right ventricle into the pulmonary artery, and note the position of the semilunar cusps of the pulmonary valve which mark the point at which the artery begins. With a pair of scissors cut from the ventricle into the artery, so disposing the incision that, if possible, it shall pass between two cusps. On laying open the artery a good view will be obtained of the *pulmonary valve*. The cusps are three in number, two anterior and one posterior. They resemble small pockets which are semilunar along their attached margin, while their free border forms two crescents (*lunulæ*) separated by an intermediate rounded projection containing a certain amount of condensed fibrous tissue known as the *corpus Arantii* [nodulus valvulæ semilunaris]. When the pulmonary artery is closed by the approximation of these valves, the three corpora Arantii meet in the centre of the lumen. It will be readily seen that the way in which the artery is closed is by the back flow of blood from the pulmonary artery to the right ventricle distending the semilunar pockets.

Now treat the parts on the left side in a similar fashion. Pass a finger from the left ventricle into the ascending aorta, and then, turning the pulmonary artery and infundibulum aside, with a pair of seissors slit open the aorta, cutting again, if possible, between the semilunar cusps. These

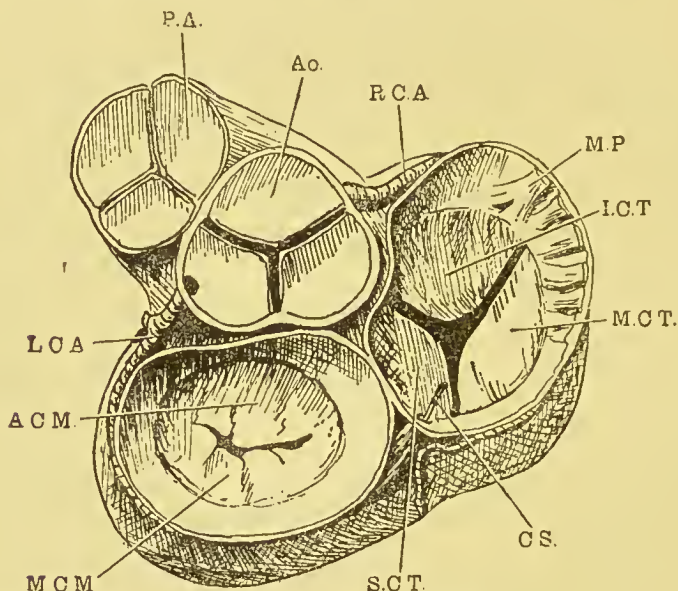


FIG. 202.—HEART WITH THE GREAT ARTERIES AND AURICLES CUT AWAY IN ORDER TO SHOW THE VALVES.

P.A. Pulmonary Artery. *Ao.* Aorta. (These vessels are cut through the Sinuses of Valsalva.) *R.C.A.* Right Coronary Artery. *L.C.A.* Left Coronary Artery. *M.P.* Musculi Pectinati of the Right Auricle. *I.C.T.* Infundibular Cusp of the Tricuspid Valve. *M.C.T.* Marginal Cusp of the Tricuspid Valve. *S.C.T.* Septal Cusp of the Tricuspid Valve. *C.S.* Rod in the opening of the Coronary Sinus. *A.C.M.* Aortic Cusp of the Mitral Valve. *M.C.M.* Marginal Cusp of the Mitral Valve.

valves will be seen to be identical in appearance to those in the pulmonary artery. They are, however, arranged so that one is situated in front, the other two behind. They mark the beginning of the aorta. It will now be understood that, despite appearances, the aorta begins at a slightly lower level and somewhat nearer the median plane than does the

pulmonary artery. If the exterior of the two large vessels be now studied at the site of the semilunar valves a slight bulging, the *sinus of Valsalva*, may be observed corresponding to each valve. From the anterior and left posterior aortic sinuses the right and left *coronary arteries* arise; these pass forwards, one on either side of the pulmonary

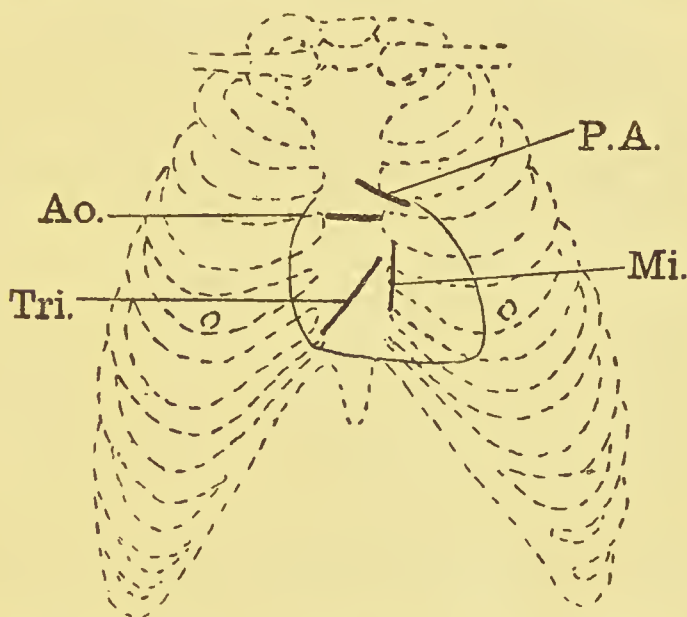


FIG. 203.—DIAGRAM TO SHOW THE POSITION OF THE VALVES OF THE HEART.

Ao. Aortic Valve. *P.A.* Pulmonary Valve. *Tri.* Tricuspid Valve.
Mi. Mitral Valve.

artery, each having the corresponding auricular appendage to its outer side (see Fig. 202).

The right coronary artery should be traced along the right auriculo-ventricular sulcus to the back of the heart until it reaches the beginning of the posterior interventricular groove. Along this it sends a well-marked inter-ventricular branch. The left coronary artery soon reaches the anterior interventricular sulcus, along which it sends

the *anterior interventricular* or *septal branch*, while the rest of the artery runs round the left side of the heart to the back in the left auriculo-ventricular sulcus. The course of these arteries is in most cases obscured by a good deal of fat. If the upper portion of the left ventricle be examined just below the aortic semilunar valves, the walls will be seen to be fibrous and therefore unaffected by the contraction of the left ventricle. This portion of the ventricle is known as the *aortic vestibule*. It permits of the free action of the semilunar valves.

The student should make himself thoroughly familiar with the appearance of these valves in the healthy condition, in order that later on he may be able to detect the earliest effects of disease.

The relation of these valves to the chest wall should be made out as far as possible, though it is of no very great clinical importance. It is given in the accompanying diagram, which may be verified by the various thoracic sections.

THE DISSECTION OF THE PLEURAL SACS AND LUNGS *IN SITU*

The dissection of the pleural sacs and lungs should now be undertaken. Begin by stripping the mediastinal pleura from the pericardium, a procedure often rendered difficult by adhesions. In the space between the two the only structures to be found are the *phrenic nerves*, one on either side, accompanied by a small companion artery, a branch of the internal mammary. The nerve may be freed from surrounding parts for an inch or two, but not further, or many of its important relations will be rendered difficult of verification.

The lung should now be pulled well outwards, thereby exposing clearly its root, from which the pleura should be carefully dissected, retaining all lymphatic nodes and trying to preserve a number of fine nerves which constitute the

anterior pulmonary plexus [plexus pulmonalis anterior], filaments from which may be traced into the substance of the lung. In an opposite direction the plexus may be traced inwards and also upwards, being formed by the union of

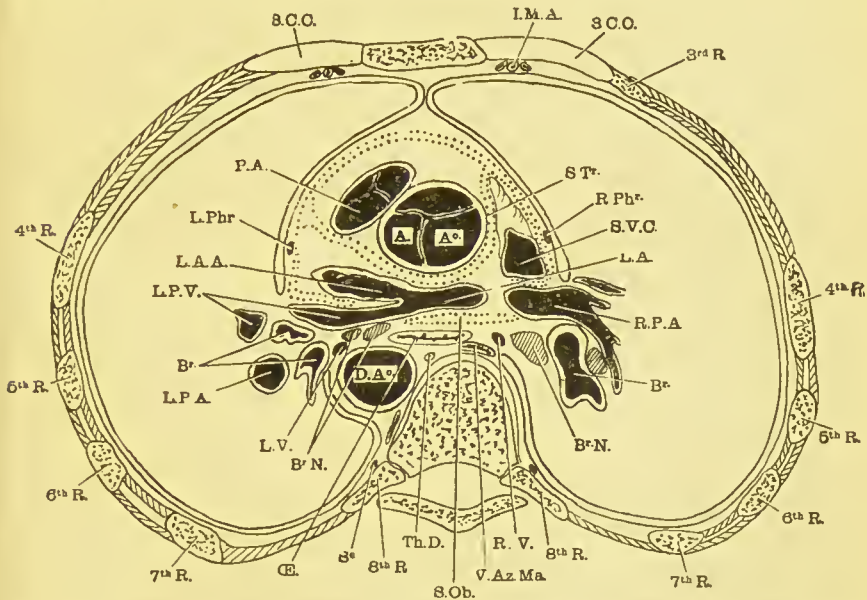


FIG. 204.—TRANSVERSE SECTION THROUGH THE THORAX AT THE LEVEL OF THE THIRD COSTAL CARTILAGE.

I.M.A. Internal Mammary Artery. *S.Tr.* Sinus Pericardii Transversus. *P.A.* Pulmonary Artery and Valve. *A.Ao.* Ascending Aorta and Valve. *R.Ph.* Right Phrenic Nerve. *L.Ph.* Left Phrenic Nerve. *S.V.C.* Superior Vena Cava opening into the Right Auricle. *L.A.* Left Auricle. *L.A.A.* Left Auricular Appendage. *L.P.V.* Left Pulmonary Vein. *R.P.A.* Right Pulmonary Artery. *L.P.A.* Left Pulmonary Artery. *B.* Bronchus. *B.N.* Bronchial Nodes. *D.A.* Descending Aorta. *E.* Esophagus. *S.* Sympathetic. *Th.D.* Thoracic Duct. *S.Ob.* Sinus Obliquus. *R.V.* Right Vagus. *L.V.* Left Vagus. *V.Az.Maj.* Vena Azygos Major.

nerves reaching the root of the lung from the vagus, just before it passes to the back of the root of the lung. The lymphatic nodes, which are black, are found in large numbers interspersed among the main constituents of the root. These constituents are the pulmonary veins, artery, and the bronchus

in this order from before backwards. Begin by clearing the *pulmonary veins* [venæ pulmonales], which are recognised by their position, and by the fact that in dissecting-room subjects they frequently contain injection. There are usually two pulmonary veins, which are formed by the union of a number of tributaries which leave the root along its anterior border and at its lower extremity.

The *pulmonary artery* [A. pulmonalis] breaks up into branches corresponding to the tributaries of the pulmonary veins, from which they are most readily distinguished by tracing them to their origin. The *bronchus* similarly breaks up into branches on entering the hilum. Its posterior position, the cartilages in its walls, and its characteristic feel to the touch make it easily identified. On comparing the root of the right lung with that of the left, it will be noticed that one of the branches of the bronchus on this side is higher than any on the left. It is known as the *eparterial bronchus* [ramus bronchialis eparterialis], because of its being situated higher than any of the branches of the pulmonary artery. All the other branches on the right side and all those on the left side are known, because of their relation to the artery, as *hyparterial*.

Having dissected the root of the lung from the front, turn the lung forwards, securing it in position by hooks if necessary. Dissect off the pleura from the back of the root, taking care to remove nothing but the membrane.

The *posterior pulmonary plexus* [Pl. pulmonalis posterior] will now be exposed, fibres from which are traceable into the lung. It will be seen to be formed by the spreading out of the fibres of the vagus and their union with branches from certain of the upper thoracic sympathetic ganglia (2, 3, and 4). The student, however, is advised not to trace the plexus at present in either an upward or downward direction. Also at the back of the root of the lung the *bronchial arteries* which supply the substance of the lung should be looked for. They are most readily picked up on the posterior surface of

the bronchus. No bronchial veins are likely to be found, and it is probable that most, if not all, of the blood carried by the bronchial arteries for the nourishment of the lungs returns through the pulmonary veins. A number of lymphatic nodes will also be seen interspersed among the other constituents of the root of the lung; they are coal black, since one of their functions is to strain off carbon deposited in the lungs from the atmosphere. They are more numerous on the right side than on the left.

The right lung may now be allowed to fall back, but it is of advantage to remove the left lung, cutting through the root close to the surface of the organ in such a way as to leave the posterior pulmonary plexus in the thorax. A good view will now be obtained of the arch of the aorta, which will be investigated later, and of the descending thoracic aorta, its continuation, while the relation of these parts to the root of the lung is fully exposed.

The *œsophagus* will also be seen and felt, lying first to the right, then in front, and lastly a little to the left of the descending thoracic aorta. On the walls of the *œsophagus* may be seen a well-marked nerve plexus—the *plexus gulæ* [plexus *œsophagei*—formed by the splitting up of the vagi as they descend from the posterior pulmonary plexus.

If now the root of the left lung be turned well forward, the *thoracic sympathetic cord* [truncus sympathicus] will be seen through the pleura, though in order to see it the cavity should be well sponged. Look for the cord in front of the heads of the ribs, and notice that at or near each rib is a ganglionic swelling.

In the lower half of the thorax a large nerve, the *great splanchnic* [N. splanchnicus major], will be found on the inner side of the sympathetic cord; it usually rises from the sixth to the ninth ganglia, though it is very variable in this respect.

Turn forward the right lung once more and notice the right sympathetic cord and great splanchnic nerve as well as

a large vein ascending in front of the bodies of the vertebræ passing behind the root of the lung and arching forward above it to open into the back of the superior vena cava where the latter emerges from the pericardium about the level of the fourth thoracic vertebra. This is the *vena azygos major* [V. azygos], which will be seen better later on.

The right lung should now be removed in the same way as the left, and the two put aside carefully in an air-tight tank or jar. Their relations cannot be studied profitably until some idea of the mediastina has been obtained.

THE MEDIASTINA

All that part of the middle of the thorax which lies between the two pleural cavities is artificially divided into superior, anterior, middle and posterior mediastina. It is therefore clear that each mediastinum will have the pleura as its lateral boundary.

The SUPERIOR MEDIASTINUM is a space bounded above by the upper oblique aperture of the thorax; below by an imaginary plane passing horizontally backwards from the junction of the manubrium and gladiolus of the sternum to the lower margin of the fourth thoracic vertebra; anteriorly by the manubrium sterni; and posteriorly by the anterior surfaces of the bodies of the upper four thoracic vertebræ.

The ANTERIOR MEDIASTINUM is that narrow space between the pleuræ which lies in front of the pericardium, below the angle of Louis, above the diaphragm and behind the gladiolus. As the pleuræ were seen to be in contact down to the level of the fourth rib, this anterior mediastinum is only a potential space until the left pleura leaves the right to form the cardiac notch.

The MIDDLE MEDIASTINUM is the part of the thorax occupied by the pericardium, but contains in addition the two phrenic nerves and the roots of the lungs.

The POSTERIOR MEDIASTINUM is the region bounded in

front by the pericardium, behind by the lower eight thoracic vertebræ, above by the imaginary plane already described as the floor of the superior mediastinum, and below by the

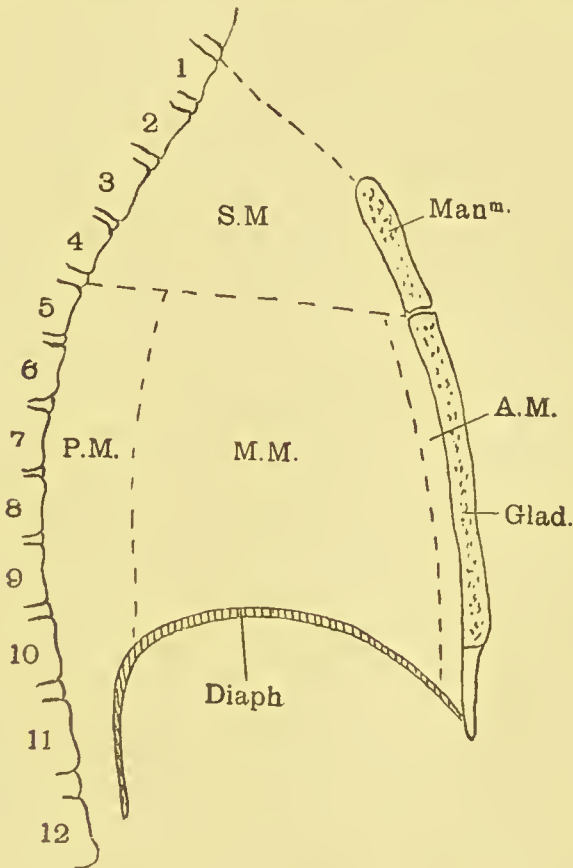


FIG. 205.—DIAGRAMMATIC SAGITTAL SECTION OF THE THORAX TO SHOW THE ARRANGEMENT OF THE MEDIASTINA.

Man^m. Manubrium Sterni. *Glad.* Gladiolus. *Diaph.* Diaphragm. *S.M.* Superior Mediastinum. *A.M.* Anterior Mediastinum. *M.M.* Middle Mediastinum. *P.M.* Posterior Mediastinum.

diaphragm, which is here running upwards much more than forwards, so that the floor of the posterior mediastinum slopes downwards and backwards very sharply indeed.

The contents of the posterior mediastinum should be

studied while the heart and pericardium are still in position, working first from the left side and afterwards from the right. Hook the pericardium and heart over to the right, and look behind them for the *descending thoracic aorta* [aorta thoracalis] beginning, where the arch of the aorta ends, at the lower level of the fourth thoracic vertebra. This great vessel will be seen to lie well to the left of the bodies of the fifth and sixth thoracic vertebræ, but to approach the mid line as it descends.

Among its branches look for the left *aortic intercostals* [aa. intercostales], nine in number, coming off the back of it, and notice how much the upper ones have to ascend to reach their proper spaces.

Dissect one or two of these arteries for some little distance by stripping away the parietal pleura, and observe the way in which they pass behind the sympathetic chain.

The *bronchial branches* [aa. bronchiales] will probably be found just behind the divided bronchi, while *œsophageal* twigs pass forwards to that tube. These, with some variable *pericardiac* [rami pericardiaci] and *mediastinal arteries* [rami mediastinales], are all the branches which need be looked for at present.

The *œsophagus* will be easily found as a large muscular tube lying in front of the aorta and just behind the pericardium; above it is to the right of the aorta, but, as it descends, the latter vessel passes more directly behind it, and quite low down the œsophagus is often a little to the left of the aorta. Be particularly careful to notice how the œsophagus passes just behind the left bronchus before reaching the back of the pericardium. In some cases of pericarditis with effusion, the pressure of the distended sinus obliquus of the pericardium causes dysphagia or difficulty in swallowing, while malignant disease in the middle of the œsophagus is liable to invade the left bronchus (see Fig. 204).

Define the œsophagus from both sides of the thorax, turning the heart and pericardium from one side to the other,

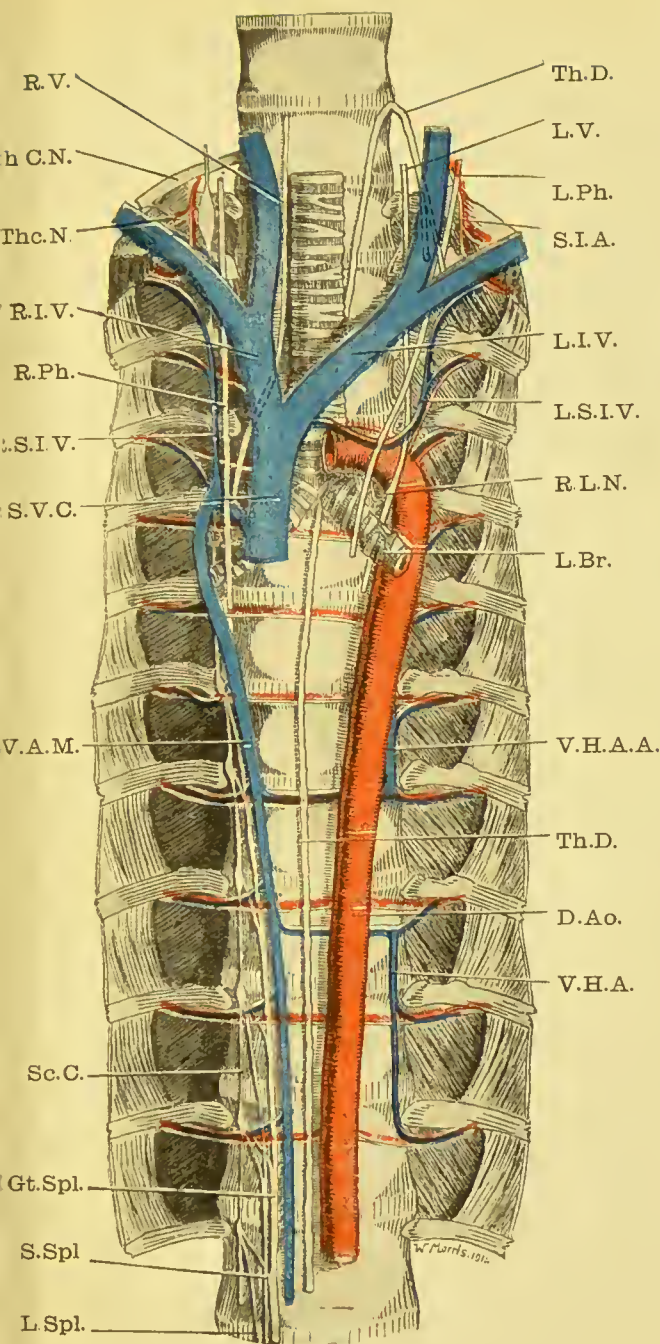


FIG. 206.—RELATIONS OF THE GREAT VESSELS AND NERVES OF THE THORAX.

R.V. Right Vagus. *L.V.* Left Vagus. *Th.D.* Thoracic Duct. *8th C.N.* 8th Cervical Nerve. *1 Thc.N.* Contribution to Brachial Plexus from the 1st Thoracic Nerve (in this case a very small contribution). *R.I.V.* Right Innominate Vein. *L.I.V.* Left Innominate Vein. *R.Ph.* Right Phrenic Nerve. *L.Ph.* Left Phrenic Nerve. *R.S.I.V.* Right Superior Intercostal Vein. *L.S.I.V.* Left Superior Intercostal Vein. *S.V.C.* Superior Vena Cava. *V.A.M.* Vena Azygos Major. *V.H.A.A.* Vena Hemiazygos Accessoria. *V.H.A.* Vena Hemiazygos. *Sc.C.* Sympathetic Cord. *Gt.Spl.* Great Splanchnic Nerve. *S.Spl.* Small Splanchnic. *L.Spl.* Least Splanchnic. *S.I.A.* Superior Intercostal Artery. *R.L.N.* Recurrent Laryngeal Nerve. *L.Br.* Left Bronchus. *Th.D.* Thoracic Duct. *D.Ao.* Descending Thoracic Aorta.

and make out the *plexus gulæ* or *œsophageal plexus* on its walls.

This is formed by the branching and joining of the vagi nerves. As the lower part of the œsophagus is approached,

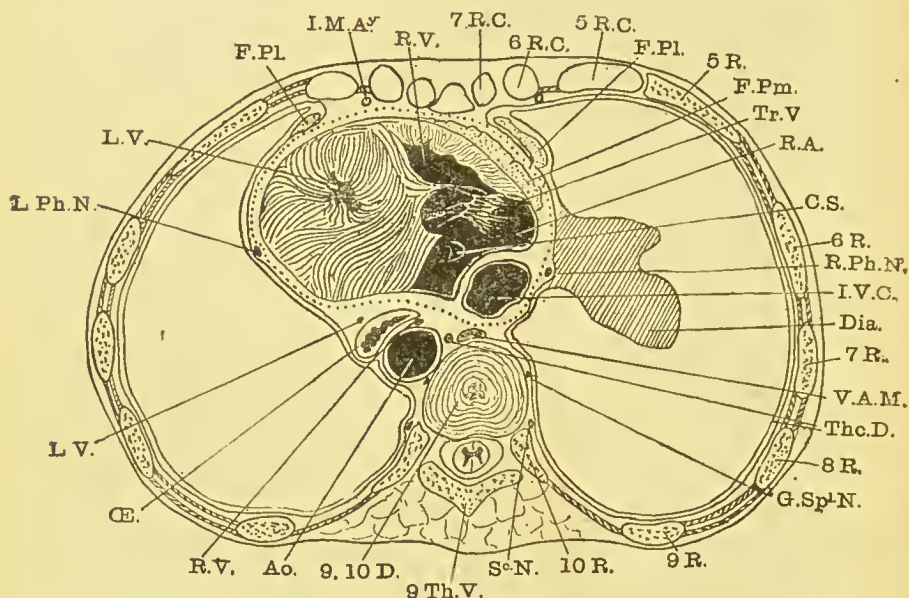


FIG. 207.—SECTION THROUGH THE DISC BETWEEN THE NINTH AND TENTH THORACIC VERTEBRÆ BEHIND AND XIPHISTERNAL JUNCTION IN FRONT.

R. stands for Rib, and *R.C.* for Rib Cartilage. *I.M.A.^y*. Internal Mammary Artery. *F.Pl.* Fatty Fold in Pleura. *F.Pm.* Fat in the Visceral Pericardium. *Tr.V.* Marginal Cusp of the Tricuspid Valve. *R.A.* Right Auricle. *C.S.* Coronary Valve. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *R.V.* Right Ventricle. *L.V.* Left Ventricle. *R.V.* (by an error the same letters have been used) Right Vagus Nerve. *L.V.* Left Vagus. *I.V.C.* Inferior Vena Cava. *Dia.* Right Cupola of Diaphragm exposed. *V.A.M.* Vena Azygos Major. *Thc.D.* Thoracic Duct. *œ*. Œsophagus. *Ao.* Descending Thoracic Aorta. *G.Sp^l.N.* Great Splanchnic Nerve. *S^c.N.* Sympathetic Nerve. The Parietal Pericardium is represented by a dotted line.

the strands of the plexus converge into two large nerves once more, the left vagus passing in front of, the right behind, the tube.

At the back of the roots of the lungs the plexus gulæ

will be found to be continuous with the posterior pulmonary plexus.

Behind the œsophagus and on the right side of the thoracic aorta, define the *vena azygos major*, a large vein, already noted, running upwards, behind the root of the right lung, and then arching forwards above the root to enter the superior vena cava on its posterior aspect. On its right side this vein receives the *lower eight intercostal veins*, and, as it is arching above the root of the lung, the *right superior intercostal*, which drains the second, third, and usually the fourth spaces (see Fig. 206).

On its left side one or sometimes two veins reach the vena azygos major in front of the eighth or ninth thoracic vertebræ. These are the azygos veins of the left side, and are often called *superior* [v. hemiazygos accessoria] and *inferior hemiazygos* [v. hemiazygos]. Trace them upwards and downwards on the left-hand side of the bodies of the vertebræ, noticing that they lie internal to and in front of the sympathetic cord, and drain the intercostal spaces of the left side of the body from the 5th to the 11th. Since they usually open into the vena azygos major about the level of the 8th thoracic vertebra, the upper one generally receives the 5th, 6th, 7th, and 8th intercostal veins, and the lower the 9th, 10th, and 11th.

The *thoracic duet* [D. thoracicus] should now be found. First retract the pericardium to the left and hook it there, then draw the œsophagus to the left and look between the thoracic aorta and vena azygos major for a collapsed thin-walled vessel looking rather like a strip of very narrow ribbon; its colour varies, sometimes being white, at others as dark as a vein, while occasionally it is double.

Posterior mediastinal lymphatic nodes [Lympho-glandulæ mediastinales posteriores] are found scattered about the mediastinum close to the thoracic aorta.

The accompanying section (Fig. 207) gives a good idea of the position of the structures in the posterior mediastinum.

THE LATERAL BOUNDARIES OF THE SUPERIOR MEDIASTINUM

Before actually dissecting this space it will be well to

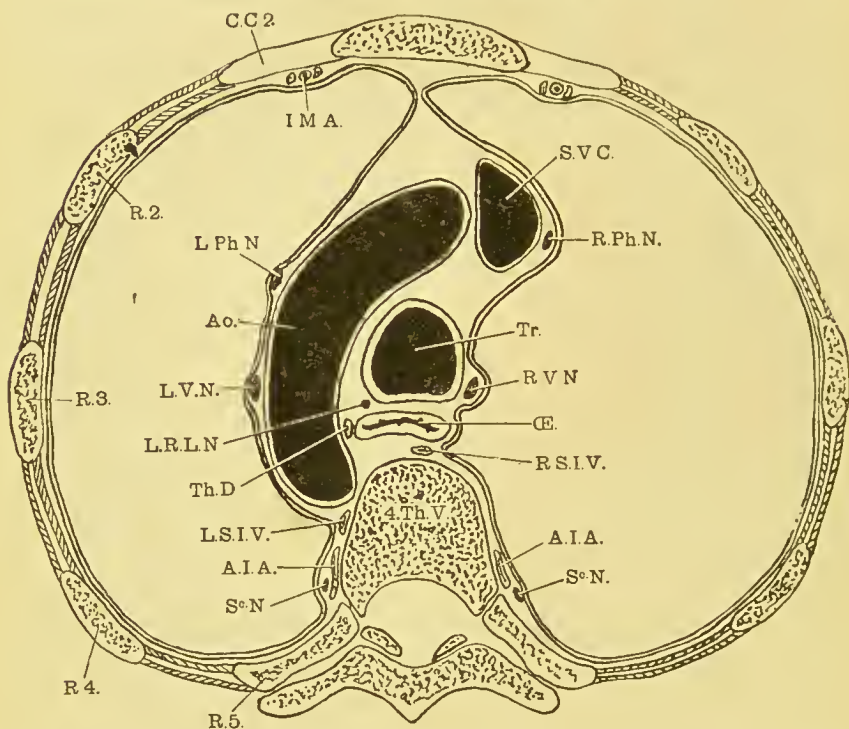


FIG. 208.—SECTION THROUGH THE FOURTH THORACIC VERTEBRA BEHIND AND THE UPPER PART OF THE SECOND COSTAL CARTILAGE IN FRONT.

I.M.A. Internal Mammary Artery. *S.V.C.* Superior Vena Cava. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *Ao.* Aortic Arch. *Tr.* Trachea. *L.V.N.* Left Vagus Nerve. *R.V.N.* Right Vagus Nerve. *L.R.L.N.* Left Recurrent Laryngeal Nerve. *Th.D.* Thoracic Duct. *Œ.* Esophagus. *R.S.I.V.* Right Superior Intercostal Vein. *L.S.I.V.* Left Superior Intercostal Vein. *A.I.A.* First Aortic Intercostal Artery. *S.c.N.* Sympathetic Nerve.

study those structures which can be seen through the pleura on each side, and consequently come into relation with the lung.

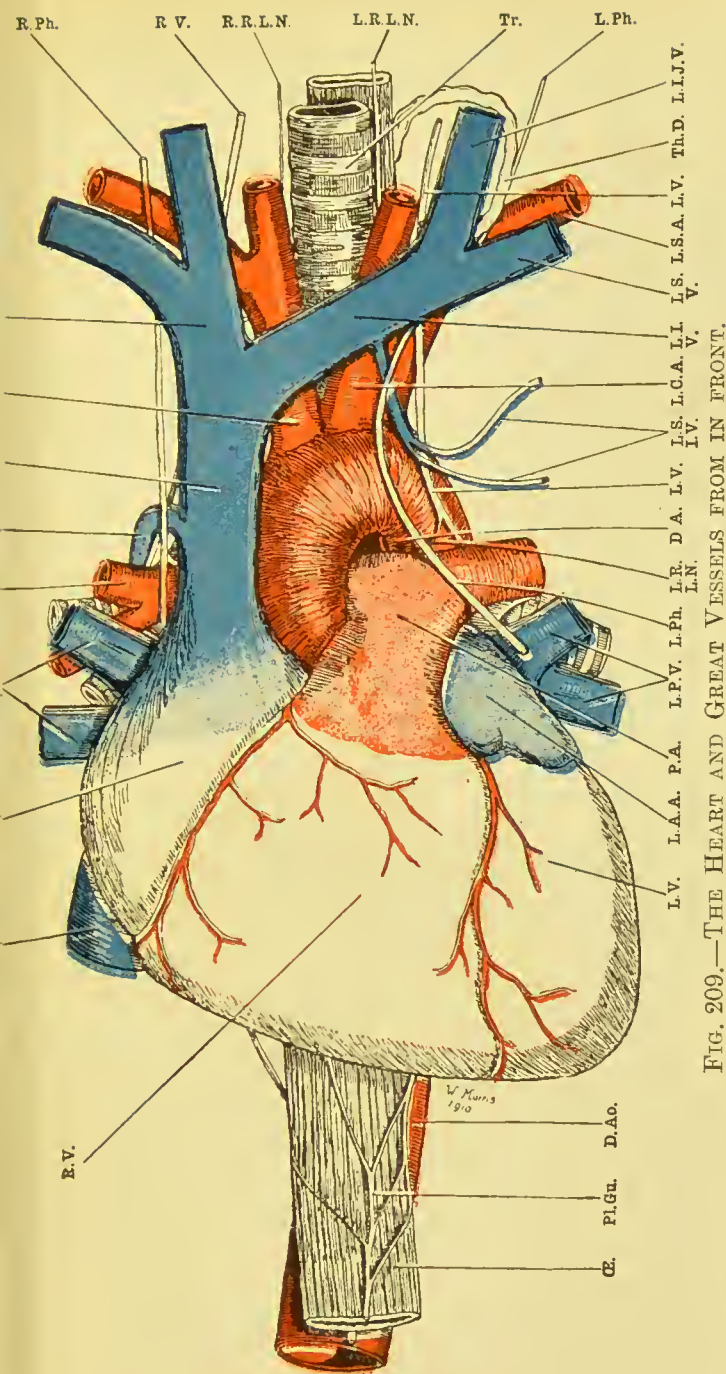


FIG. 209.—THE HEART AND GREAT VESSELS FROM IN FRONT.

R.R.L.N. Right Recurrent Laryngeal Nerve. *L.R.L.N.* Left Recurrent Laryngeal Nerve. *R.V.* Right Vagus. *L.V.* Left Vagus. *R.Ph.* Right Phrenic Nerve. *L.Ph.* Left Phrenic Nerve. *R.I.V.* Right Innominate Vein. *L.I.V.* Left Innominate Vein. *I.A.* Innominate Artery. *S.V.C.* Superior Vena Cava. *V.A.M.* Vena Azygos Major. *P.A.* Pulmonary Artery. *R.P.V.* Right Pulmonary Veins. *L.P.V.* Left Pulmonary Veins. *R.A.* Right Auricle. *R.V.* Right Ventricle. *L.V.* Left Ventricle. *Tr.* Trachea. *Th.D.* Thoracic Duct. *L.S.A.* Left Subclavian Artery. *L.S.V.* Left Subclavian Vein. *L.C.A.* Left Carotid Artery. *L.S.I.V.* Left Superior Intercostal Vein. *D.A.* Ductus Arteriosus. *L.A.A.* Left Auricular Appendage. *D.Ao.* Descending Thoracic Aorta. *Pl.Gu.* Plexus Gulæ. *OE.* Oesophagus.

Sponge the parietal pleura carefully, but do not cut through it at present.

On the left side the great convexity of the *arch of the aorta* [arcus aortæ] will be very evident. Notice that this runs as much backwards as it does to the left, and that it corresponds in level to the lower half of the manubrium sterni in front, and to the body of the fourth thoracic vertebra behind.

Springing from the top of the aortic arch the left subclavian artery will be seen arching upwards above and in front of the dome of the pleura; it makes a most prominent ridge behind which the œsophagus will be felt.

The thoracic duct cannot be either seen or felt, but if an incision is made through the pleura just behind and parallel with the ridge formed by the left subclavian artery, the duct will be found quite easily. The left carotid artery seldom forms an elevation as the left subclavian does, but it may easily be felt, lying against the pleura, in front and to the right of that vessel. Nearer still to the middle line and still more anteriorly, the innominate artery will be felt on deep pressure (see Fig. 213).

The outlines of the left phrenic and vagus nerves are to be made out through the pleura, gradually diverging as they go down, so that the former may pass in front of and the latter behind the root of the lung.

As one passes from right to left in front of the upper part of the aortic arch, the *left superior intercostal vein* is easily seen through the pleura; after passing in front of the left vagus, it turns rather sharply upwards to open into the left innominate vein.

Below the aorta, in its concavity, notice the pulmonary artery while, above, the left innominate vein may just be felt and seen lying, as it does, behind the upper half of the manubrium sterni.

On the right side the upper half of the superior vena cava is in the superior mediastinum, as is also the arch of

the vena azygos major. Press rather firmly with the finger behind the vena cava and above the arch of the vena azygos

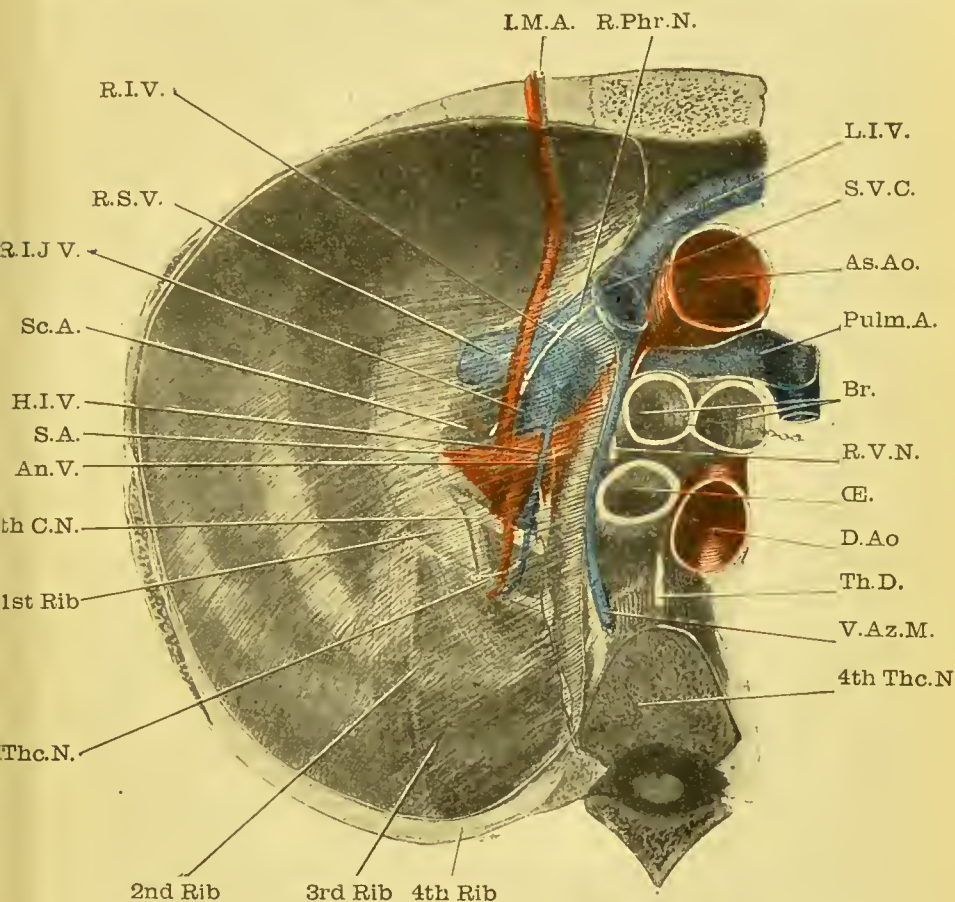


FIG. 210.—THE DOME OF THE RIGHT PLEURA AND ITS RELATIONS.

I.M.A. Internal Mammary Artery. *R.Phr.N.* Right Phrenic Nerve. *L.I.V.* Left Innominate Vein. *R.I.V.* Right Innominate Vein. *R.S.V.* Right Subclavian Vein. *R.I.J.V.* Right Internal Jugular Vein. *S.V.C.* Superior Vena Cava. *Sc.A.* Scalenus Anticus Insertion. *H.I.V.* Highest Intercostal Vein. *S.A.* Subclavian Artery. *An.V.* Annulus of Vieussens. *8th C.N.* 8th Cervical Nerve. *1st Thc.N.* 1st Thoracic Nerve. *As.Ao.* Ascending Aorta. *Pulm.A.* Pulmonary Artery. *Br.* Bronchi. *R.V.N.* Right Vagus Nerve. *Œ.* Esophagus. *D.Ao.* Descending Thoracic Aorta. *Th.D.* Thoracic Duct. *V.Az.M.* Vena Azygos Major. *4th Thc.V.* Lower Part of the Fourth Thoracic Vertebrae.

N.B.—The pointers to Ribs 1, 2, and 3 cross the Subcostal Muscles.

major, and the rings of the trachea will probably be felt. Further upwards, near the dome of the pleura, feel for the outward sweep of the innominate artery and its continuation the right subclavian. The outline of the right phrenic nerve is easily traced upwards along the right side of the superior vena cava, from where it is exposed in front of the root of the lung, but the position of the right vagus is more difficult to localise; the best way is to trace it up with the finger from behind the root of the lung, where it forms the posterior pulmonary plexus, along the right side of the trachea, but remember that, as it runs upwards, it comes forwards so as to gain the interval between the right subclavian vein in front and the corresponding artery behind.

Notice that the œsophagus does not always come into contact with the right pleura in the superior mediastinum.

FORM AND RELATIONS OF THE LUNGS AFTER REMOVAL

Now that the structures in contact with the parietal pleura have been localised, the relations of the lungs will be more easy to follow. In formalin-hardened bodies the lungs usually preserve their shape very well, and the various mouldings of surrounding vessels and viscera are often quite clear. If, however, from disease or imperfect injection, the lungs are useless, the student is advised to refer to the models of His, which are available in almost every dissecting-room.

Notice that each lung is a pyramid, the apex of which projects upwards into the root of the neck, while the base is deeply concave for the cupola of the diaphragm.

Laterally, each lung is markedly convex from before backward, and usually shows shallow grooves running downwards and forwards, where it presses against the ribs. The medial surface shows the cut root, and in front of that a concavity to receive the heart and pericardium.

The ventral border of each lung is sharp, while the

dorsal is very thick and rounded, so that the greater mass of lung tissue is situated in the postero-lateral part of the thorax.

Notice that the right lung is shorter from base to apex than the left, since the diaphragm ascends higher on the right side, but as the heart is more on the left side of the thorax, it is wider from side to side and capable of containing more air.

In this lung there are three lobes separated by two fissures. The *primary fissure* [incisura interlobaris] begins at the top of the root (see Fig. 211), about the level of the fifth rib, and may be traced round the convex surface in a downward and forward direction till it reaches the base about the eighth rib; it then runs across the base and turns up on the pericardial aspect to reach the lower part of the root.

The *secondary fissure* begins behind, about the middle of the primary, and runs almost horizontally forwards. Internally it will be seen to reach the most anterior part of the root.

In the left lung there are only two lobes and one fissure; this corresponds to the primary fissure of the right lung, save that it ascends rather higher after leaving the top of the root, and runs farther forward at the base.

Look at the divided structures at the root of the lung; they have been identified already, but it will now be seen that the cut reflexion of the pleura at the root has a somewhat racket-shaped outline, the handle of the racket being below, formed by the ligamentum latum pulmonis.

Close to this ligament is always found the lowest pulmonary vein, while the other one is farther forward.

Notice how little difference there is between the thickness of the coats of the artery and vein.

The bronchi are easily distinguishable by their rings, and the cparterial bronchus must be carefully looked for on the right side, above the level of the pulmonary artery. The medial relations of the right lung should be studied next.

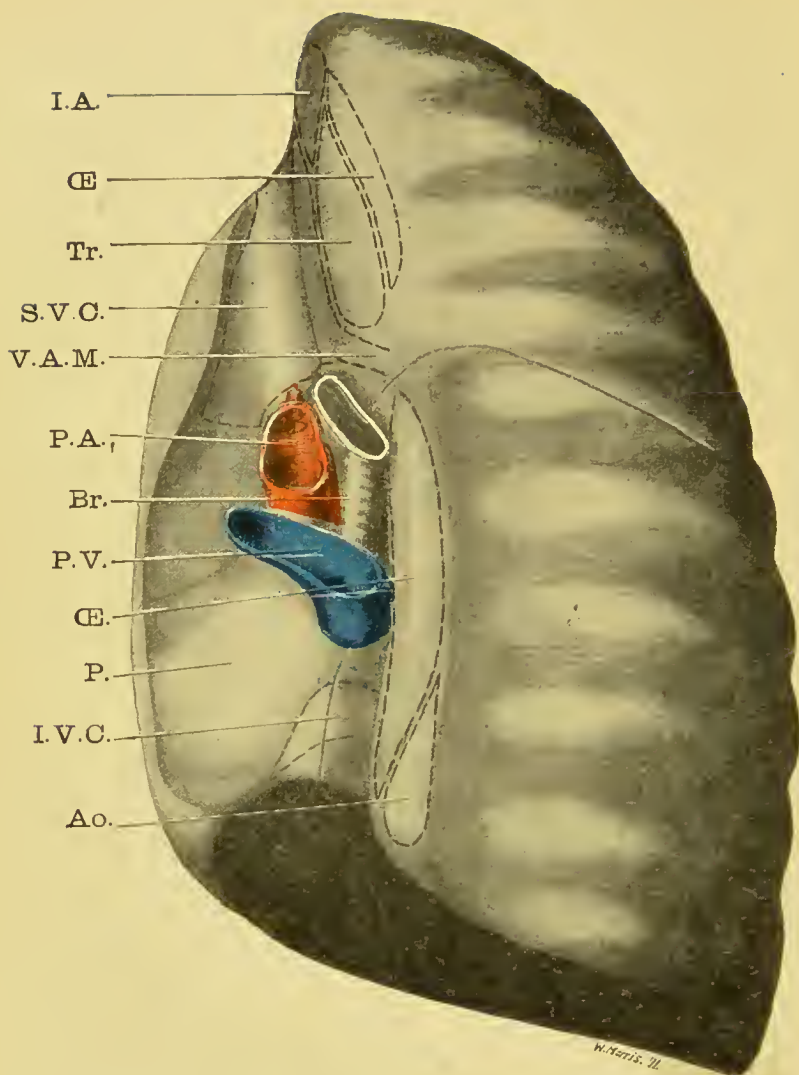


FIG. 211.—MEDIAL SURFACE OF THE RIGHT LUNG.

I.A. Innominate Artery. *Æ.* Esophagus. *Tr.* Trachea. *S.V.C.* Superior Vena Cava. *V.A.M.* Vena Azygos Major. *P.A.* Pulmonary Artery. *Br.* Bronchus. *P.V.* Pulmonary Vein. *P.* Pericardium. *I.V.C.* Inferior Vena Cava. *Ao.* Aorta.

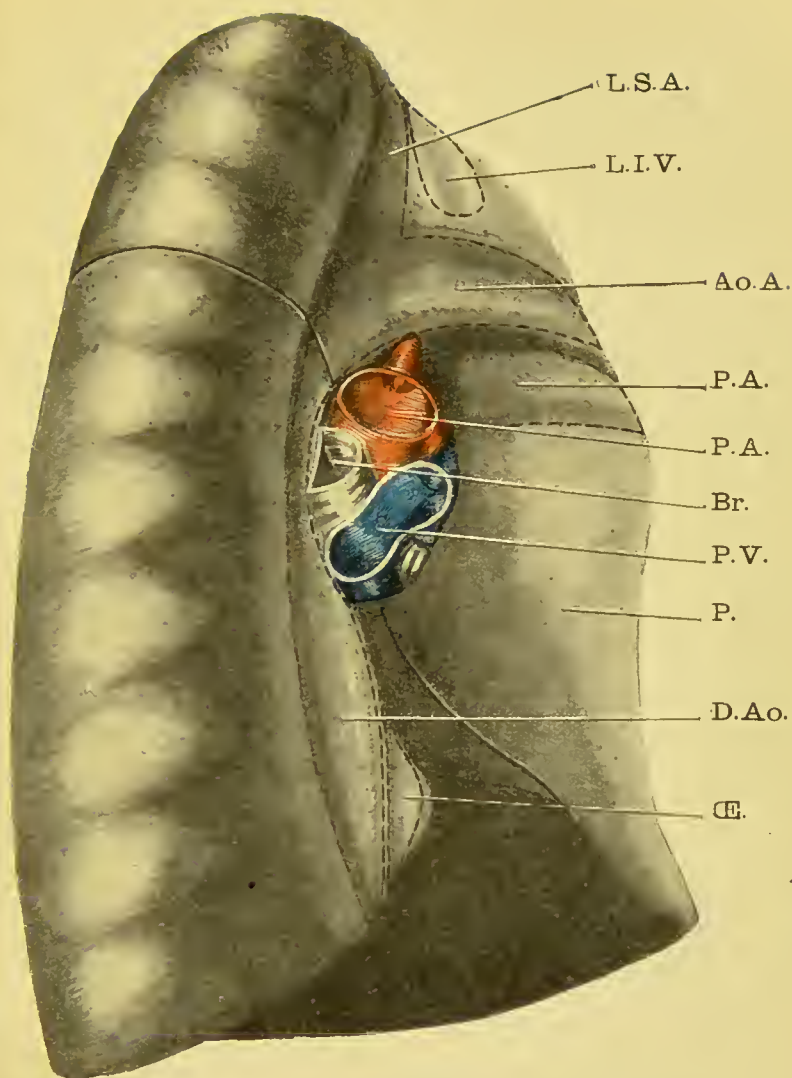


FIG. 212.—MEDIAL SURFACE OF THE LEFT LUNG.

L.S.A. Left Subclavian Artery. *L.I.V.* Left Innominate Vein. *Ao.A.* Aortic Arch. *P.A.* Pulmonary Artery. *Br.* Bronchus. *P.V.* Pulmonary Vein. *P.* Pericardium. *D.Ao.* Descending Thoracic Aorta. *Œ.* Esophagus.

In front of the root is the pericardial concavity (Fig. 211 P.), down which the phrenic nerve runs. Below this the inferior vena cava (I.V.C.) grooves the lung. Above the pericardial area runs the superior vena cava (S.V.C.), while, arching over the root, is a groove for the vena azygos major (V.A.M.), which here keeps the vagus off the lung.

Behind the superior caval groove the trachea (T.) is in contact with the lung, the vagus passing obliquely downwards and backwards between the lung and the trachea, while above the trachea the innominate and subclavian arterial groove begins (I.A.). Behind the root is the œsophageal groove (Æ.), which may or may not be continued up above the azygos vein, while below, the aorta (Ao.) usually just touches this lung.

On the medial surface of the left lung the arch of the aorta makes a wide and definite groove above the root; this is continued down behind the root to the lower margin of the lung (see Fig. 212, Ao.). Here the œsophagus (Æ.) reaches the lung in front of the aorta. This explains the clinical fact that malignant disease of the lower end of the œsophagus may invade either of the lungs or pleural sacs.

Running upwards from the convexity of the groove for the aortic arch to just in front of the apex of the lung is a groove for the left subclavian artery (S.A.), and in front of that another for the left innominate and subclavian veins (I.V.). The pulmonary artery makes a nearly horizontal groove (P.A.) just below that for the arch of the aorta, and below this again is the concavity for the pericardium.

The anterior border of this lung is usually more or less deeply indented to form the *cardiac notch*, and for this reason the pericardial area is not so large as it would otherwise be.

DISSECTION OF THE MEDIASTINA

The dissection of the upper part of the thorax has been purposely left till a late period, in order to allow the dissectors

of the head and neck time to deal with the structures at the root of the neck.

They will probably by now have advanced so far that the first rib and manubrium sterni are no longer of importance to them, and the upper part of the manubrium, which has hitherto been left intact, may be divided in the mid line by a saw-cut, though this should be carefully made and should only just divide the bone.

Now divide the first rib on each side with the bone forceps, about an inch external to the tubercle, after which, by carefully freeing the subjacent soft parts, the rib with half the manubrium may be turned outwards on each side, as a book is opened. This method allows the parts to be replaced from time to time for reference.

Look for the origins of the *sterno-hyoid* and *sterno-thyroid* muscles on the back of the manubrium, the former extending outwards to the back of the sternal end of the clavicle and posterior sterno-clavicular ligament, the latter to the posterior surface of the inner end of the first rib.

Some dark-coloured fibro-fatty tissue will now be exposed, which represents the remains of the *thymus gland*. It is said that careful microscopic examination will always show thymic tissue scattered among this fat, even in very old subjects.

On cleaning away this tissue the large veins are seen. These are the right and left innominate veins, with their tributaries, and the upper half or extra-pericardial portion of the superior vena cava receiving the vena azygos major. It must be noted that only the termination of this latter vein lies in the superior mediastinum.

The formation of the *innominate veins* [venæ anonymæ] by the junction of the internal jugular and subclavian takes place in the root of the neck and is studied there. It will be seen that the right innominate passes almost vertically downwards for about an inch (see Fig. 206), but that the left, nearly three times as long, runs almost horizontally behind the upper half of the manubrium to join the right behind the

junction of the first right intercostal space with the manubrium. Notice very carefully whether the left innominate vein appears above the supra-sternal notch. It does so sometimes, more often in children, and then may be a source of great danger in operations at the root of the neck.

Both innominate veins receive the *internal mammary* [v. *mammaria interna*] and *vertebral veins* [v. *vertebrales*] as tributaries, the latter opening just below the orifice of the internal jugular, and already exposed by the dissectors of the neck. In addition to these, the left innominate receives the left superior intercostal and the inferior thyroid veins.

Dissect the *left superior intercostal vein* from the place where it has been seen already, through the pleura in front of the arch of the aorta, and notice that it drains the second, third, and usually the fourth intercostal spaces. The corresponding *right superior intercostal* will be found opening into the arch of the vena azygos major.

The *inferior thyroid vein* [v. *thyreoidea inferior*] descends in front of the trachea to enter the left innominate close to the middle line. With a high innominate it does not enter the superior mediastinum at all.

The *superior vena cava*, which begins behind the first intercostal space on the right side, ends behind the third by opening into the right auricle. It is divided for descriptive purposes into two parts—an upper extra-pericardial, a lower intra-pericardial. The upper portion receives the large vena azygos major and a few small tributaries from the pericardium. Its right side is in direct relationship to the right phrenic nerve and the right pleura, while its left side is in contact with the ascending aorta below, with the arch of the aorta and the innominate artery above (see Fig. 213).

After the veins the nerves should be studied. The *phrenic* and *vagus* have already been seen. Many of their relations on opposite sides of the body are dissimilar, but not all: it is convenient to remember that the following statement is true for both sides, viz. the phrenic and vagus

nerves before entering the thorax cross in front of an artery and behind a vein; the artery is the subclavian; the vein in relation to the phrenic is the subclavian or the beginning

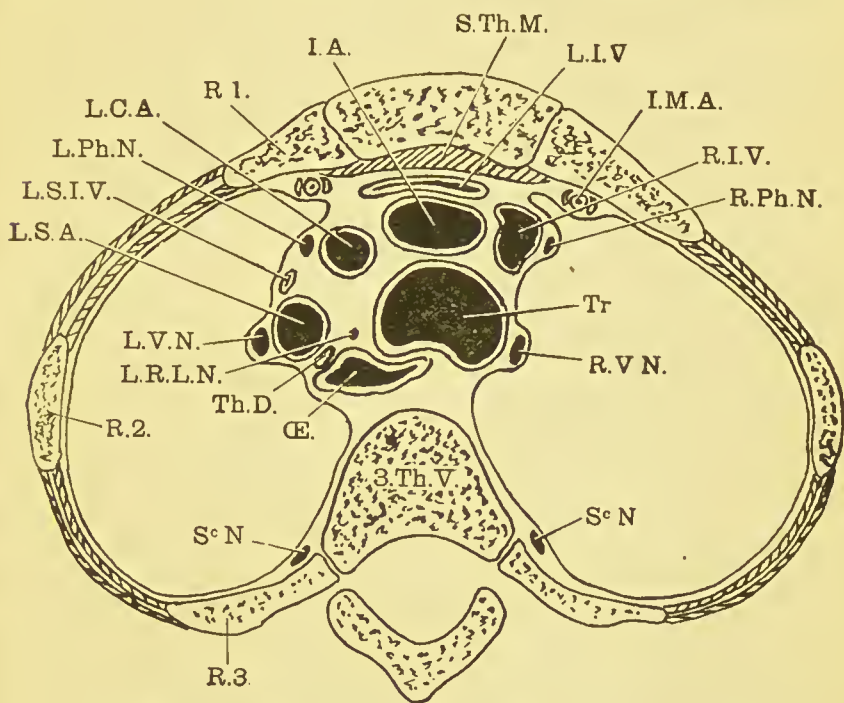


FIG. 213.—SECTION THROUGH THE FIRST RIB IN FRONT AND THE THIRD THORACIC VERTEBRA BEHIND.

S.Th.M. Sterno-thyroid Origin. *L.I.V.* Left Innominate Vein. *I.M.A.* Internal Mammary Artery. *R.I.V.* Right Innominate Vein. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *I.A.* Innominate Artery. *L.C.A.* Left Carotid Artery. *L.S.A.* Left Subclavian Artery. *L.S.I.V.* Left Superior Intercostal Vein. *L.V.N.* Left Vagus Nerve. *R.V.N.* Right Vagus Nerve. *L.R.L.N.* Left Recurrent Laryngeal Nerve. *Tr.* Trachea. *œ.* Esophagus. *Th.D.* Thoracic Duct. *Sc.N.* Sympathetic Nerve.

of the innominate; that in relation to the vagus the innominate. In other words, as would be expected from their relationship in the neck, the vagus is more median than the phrenic. In the thorax the phrenic crosses the vagus very

obliquely from without inward. Lastly, the phrenic passes to the front of the root of the lung; the vagus to the back. In other particulars the relations on the two sides vary. Study the right side first.

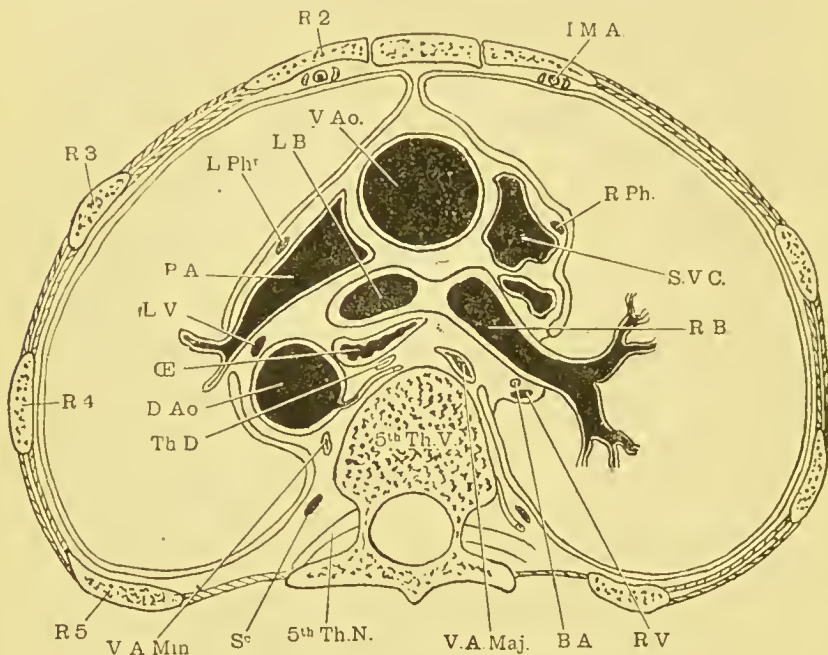


FIG. 214.—SECTION THROUGH THE LOWER PART OF THE SECOND COSTAL CARTILAGE IN FRONT AND THE FIFTH THORACIC VERTEBRA BEHIND.

I.M.A. Internal Mammary Artery. *V.A.o.* Ascending Aorta. *D.A.o.* Descending Thoracic Aorta. *L.Br.* Left Bronchus. *R.Br.* Right Bronchus. *L.Ph.* Left Phrenic Nerve. *R.Ph.* Right Phrenic Nerve. *S.V.C.* Superior Vena Cava. *P.A.* Pulmonary Artery (in front of the Right Bronchus another branch of this is seen). *L.V.* Left Vagus. *R.V.* Right Vagus. *C.E.* Oesophagus. *Th.D.* Thoracic Duct. *V.A.Maj.* Vena Azygos Major. *V.A.Min.* Vena Azygos Minor. *B.A.* Bronchial Artery. *S.c.* Sympathetic.

The *phrenic nerve* will be found immediately to the right of the superior vena cava, both structures being in intimate contact with the mediastinal pleura. Lower down, the phrenic lies between the pleura and pericardium, to both of

which it furnishes fine twigs. The right phrenic breaks up and pierces the dome of the diaphragm, a few filaments passing with the inferior vena cava through its aperture.

Put in another way, the right phrenic nerve is found on the right side of both the superior and inferior venæ cavæ; between the two it lies to the right of the right auricle, the pericardium intervening (see Figs. 207, 215, R.Ph.N.).

The *right vagus* [n. vagus] having entered the thorax lies close to the right side of the trachea, running obliquely backwards as it descends. It then passes behind the root of the lung, where it has already been seen forming the posterior pulmonary plexus (see Figs. 207, 214, and 215, R.V.N.). From here it is traceable to the plexus gulæ, lying chiefly behind the œsophagus, with which it leaves the thorax through the œsophageal aperture of the diaphragm. Now examine the nerves on the left side.

The *left phrenic* and *left vagus* have been seen already crossing in front of the arch of the aorta, and from this point they may be followed in both directions (see Fig. 215, L.P.N. and L.V.N.). Above the arch they are soon lost behind the innominate vein, but if this structure is reflected they may be followed up into the neck. At the lower level of the arch of the aorta the superior mediastinum ends, and below this the phrenic lies in the middle mediastinum, crossing in front of the root of the lung, and being pushed to the left by the pericardium. It pierces the diaphragm after breaking up into branches.

Notice that it has a longer course than the right nerve, partly because the diaphragm is lower on the left side and partly because of its wandering to the left behind the pericardium (see Fig. 207).

As the *left vagus* lies in front of the aortic arch, it gives off the *left recurrent laryngeal nerve* [N. recurrens] (Fig. 209, L.R.L.N.), which is soon lost to view as it curves back between the arch and the pulmonary artery. This looping of

the nerve behind and below the aortic arch accounts for the clinical fact that sometimes the earliest sign of an aortic aneurism or dilatation of the arch is loss of voice from paralysis of the laryngeal muscles which this nerve supplies.

While the front of the arch is being dissected a close look-out should be kept for two minute nerves passing to the *superficial cardiac plexus*, which lies in the concavity of the aorta. They lie between the vagus and phrenic, and are the *left superior cervical cardiac of the sympathetic*, nearer the vagus, and the *left inferior cervical cardiac of the vagus*, nearer the phrenic. A good deal of skill is required in order to find them.

Behind the nerves the great arteries occupy the superior mediastinum. They are the arch of the aorta with its three great branches. Before beginning their dissection study the accompanying diagram of a horizontal section through the superior mediastinum, or, if an actual section is at hand, study that (Figs. 215, 216).

The *arch of the aorta* begins at the top of the pericardium, where it is continuous with the ascending aorta behind the second right costal cartilage. Here it most nearly approaches the anterior wall of the chest, and consequently the sounds of the aortic valve are best heard here with the stethoscope.

From its origin it inclines obliquely backwards and to the left to end at the lower border of the fourth thoracic vertebra. In the concavity of its arch lies the root of the left lung. If these two structures be separated, a fibrous cord covered by pleura may be seen passing between them; it is the obliterated ductus arteriosus, and will be studied more fully later (see Fig. 209, D.A.). Arising from the convexity of the arch are, from right to left, the *innominate* [A. anonyma], the *left common carotid* [A. carotis], and the *left subclavian arteries* [A. subclavia]. The first comes into relation with the right pleura, and for some distance lies directly in front of the trachea; the other two arterial trunks

come into relation with the left pleura—the carotid in front, the subclavian farther back. They are in direct apposition to the pleura, as has been seen already. Further, the

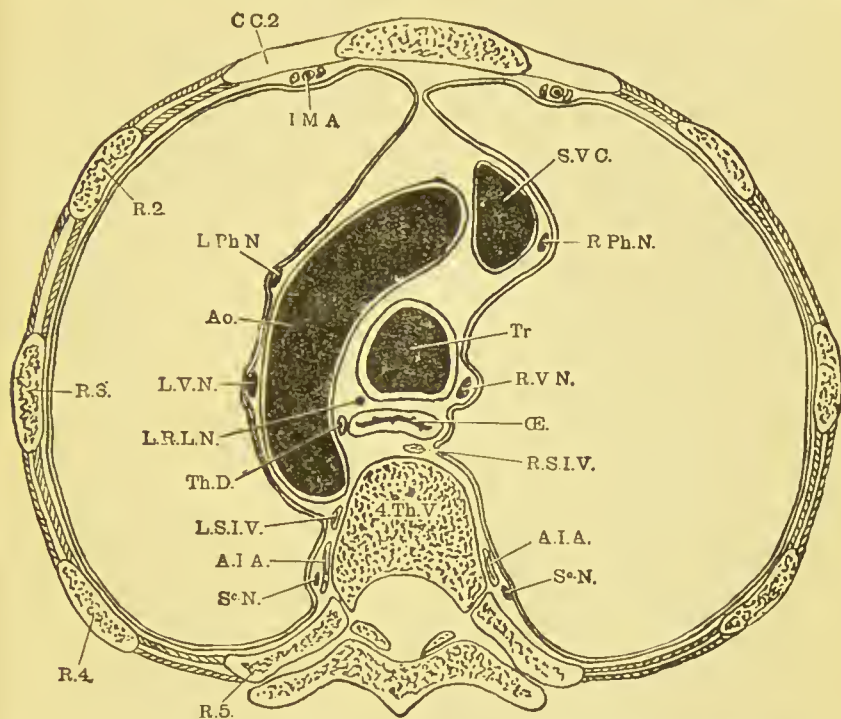


FIG. 215.—SECTION THROUGH THE FOURTH THORACIC VERTEBRA BEHIND AND THE UPPER PART OF THE SECOND COSTAL CARTILAGE IN FRONT. (TRACED FROM NATURE WITH A DIAGRAPH.)

I.M.A., Internal Mammary Artery. *S.V.C.*, Superior Vena Cava. *R.Ph.N.*, Right Phrenic Nerve. *L.Ph.N.*, Left Phrenic Nerve. *Ao.*, Aortic Arch. *Tr.*, Trachea. *L.V.N.*, Left Vagus Nerve. *R.V.N.*, Right Vagus Nerve. *L.R.L.N.*, Left Recurrent Laryngeal Nerve. *Th.D.*, Thoracic Duct. *Es.*, Esophagus. *R.S.I.V.*, Right Superior Intercostal Vein. *L.S.I.V.*, Left Superior Intercostal Vein. *A.I.A.*, First Aortic Intercostal Artery. *S.C.N.*, Sympathetic Nerve.

nerves and vein already mentioned as crossing the arch do so between these two arterial trunks (Fig. 216).

The anterior or left relations of the aortic arch have already been considered. Recapitulated they are: (1) lungs

and pleuræ; (2) left phrenic; (3) left vagus; (4) cardiac branches to superficial cardiac plexus; (5) left superior intercostal vein; (6) remains of thymus gland.

In order to see the posterior relations the aortic arch with the heart attached must be hooked over as far as possible to the left. There will then be seen from right to left: (1) the trachea; (2) deep cardiac plexus; (3) left recurrent laryngeal nerve; (4) œsophagus; (5) thoracic duct; (6) body of the fourth thoracic vertebra (Fig. 215).

Above it is in relation to the three large vessels which spring from it and to the left innominate vein. Below, in its concavity, are situate the bifurcations of the trachea and of the pulmonary artery, while superficial to both lies the superficial cardiac plexus. Owing to the fact that the arch of the aorta is astride of the left bronchus, one of the symptoms of aortic aneurism is known as the "tracheal tug," which can be felt by holding the trachea between the finger and thumb in the neck. It is caused by the pulsation of the distended aorta. On both sides of the median plane the arch has in front of it the corresponding pleural sac. From these relations it will be readily understood that any enlargement of the arch, such as occurs in aneurism, will necessarily cause pressure upon the trachea, œsophagus, and recurrent laryngeal nerve, with consequent loss of voice and difficulty in breathing and swallowing.

The *innominate artery* [A. anonyma] is the first and largest branch of the aortic arch. Arising near the mid line it passes upwards and to the right to end behind the sterno-clavicular articulation by dividing into the right subclavian and right common carotid. In its course it lies first in front of the trachea and right vagus, then of the right pleural sac and the apical part of the right lung. It is crossed near its origin by the left innominate vein, while, as already stated, its termination is behind the sterno-clavicular joint. To its right is the right innominate vein and the upper part of the superior vena cava, which intervene to

some extent between it and the right pleural sac (see Fig. 216, I.A.). To the left is first the left common carotid artery and later the trachea. As a rule, the innominate artery

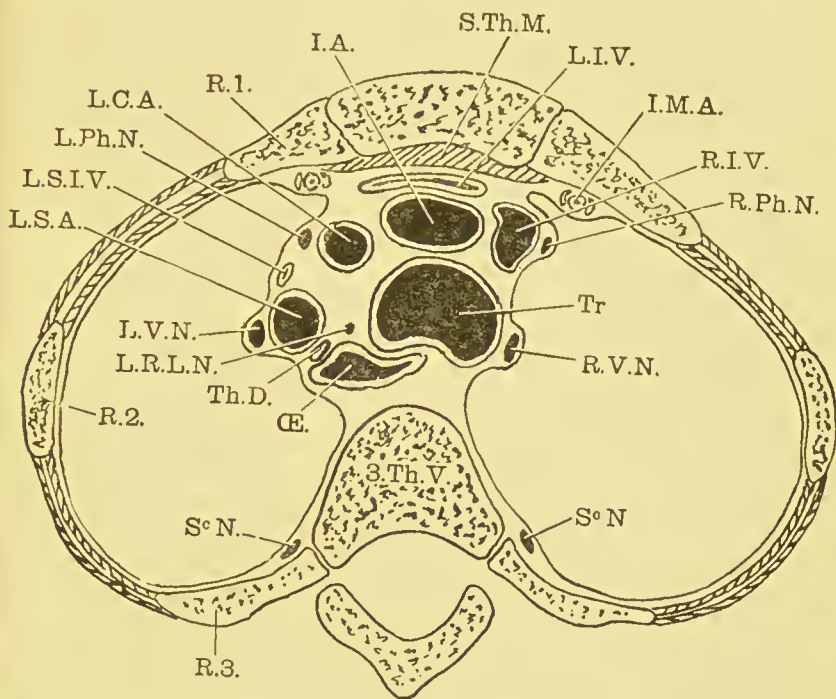


FIG. 216.—SECTION THROUGH THE FIRST RIB IN FRONT AND THE THIRD THORACIC VERTEBRA BEHIND.

S.Th.M. Sterno-thyroid Origin. *L.I.V.* Left Innominate Vein. *I.M.A.* Internal Mammary Artery. *R.I.V.* Right Innominate Vein. *R.Ph.N.* Right Phrenic Nerve. *L.Ph.N.* Left Phrenic Nerve. *I.A.* Innominate Artery. *L.C.A.* Left Carotid Artery. *L.S.A.* Left Subclavian Artery. *L.S.I.V.* Left Superior Intercostal Vein. *L.V.N.* Left Vagus Nerve. *R.V.N.* Right Vagus Nerve. *L.R.L.N.* Left Recurrent Laryngeal Nerve. *Tr.* Trachea. *Æ.* Esophagus. *Th.D.* Thoracic Duct. *S° N.* Sympathetic Nerve.

gives off no branch, but occasionally a branch may be seen proceeding to the thyroid gland, termed the *arteria thyroidea ima*.

The left common carotid artery springs from the con-

vexity of the aortic arch immediately to the left of and a little behind the innominate artery. It courses upwards and to the left to leave the thorax by passing behind the left sternoclavicular articulation. In front lies the left innominate vein; behind, the trachea; and later the left subclavian artery with the nerves and vein crossing the arch of the aorta. Behind it, too, are the œsophagus, thoracic duct, and recurrent laryngeal nerves. To the right will be found the innominate artery and then the trachea; to the left the left phrenic nerve and superior intercostal vein together with the left pleural sac (see Fig. 216, L.C.A.).

The left subclavian artery springs from the aortic arch some little distance to the left of and behind the origin of the left common carotid. It courses upwards and to the left, entering the neck a little to the outer side of the sternoclavicular joint. In front of it are the left common carotid artery, the nerves and vein crossing the aortic arch and superficial to all the left innominate vein. Behind it are, below, the left recurrent laryngeal nerve, the œsophagus, and thoracic duct; above, the left pleural sac and left lung. To the right are the left common carotid artery, the four nerves already mentioned, the left superior intercostal vein and the trachea (see Fig. 217, L.S.A.). To the left are the left pleural sac and left lung. It is now necessary to examine the structures in the concavity of the aortic arch. Begin by tracing the *pulmonary artery* [A. pulmonalis] from its origin to its bifurcation, and note that, while the main trunk lies within the pericardium, the right and left divisions are without. Close to the origin of the left pulmonary artery a fibrous cord will be seen to leave that vessel and to pass upwards and backwards to be attached to the aortic arch on its concave side a little beyond the origin of the left subclavian artery. It is the *obliterated ductus arteriosus*, to the left of which the left recurrent laryngeal nerve will be seen to hook. If now the space between the arch of the aorta above and the diverging pulmonary arteries below be carefully

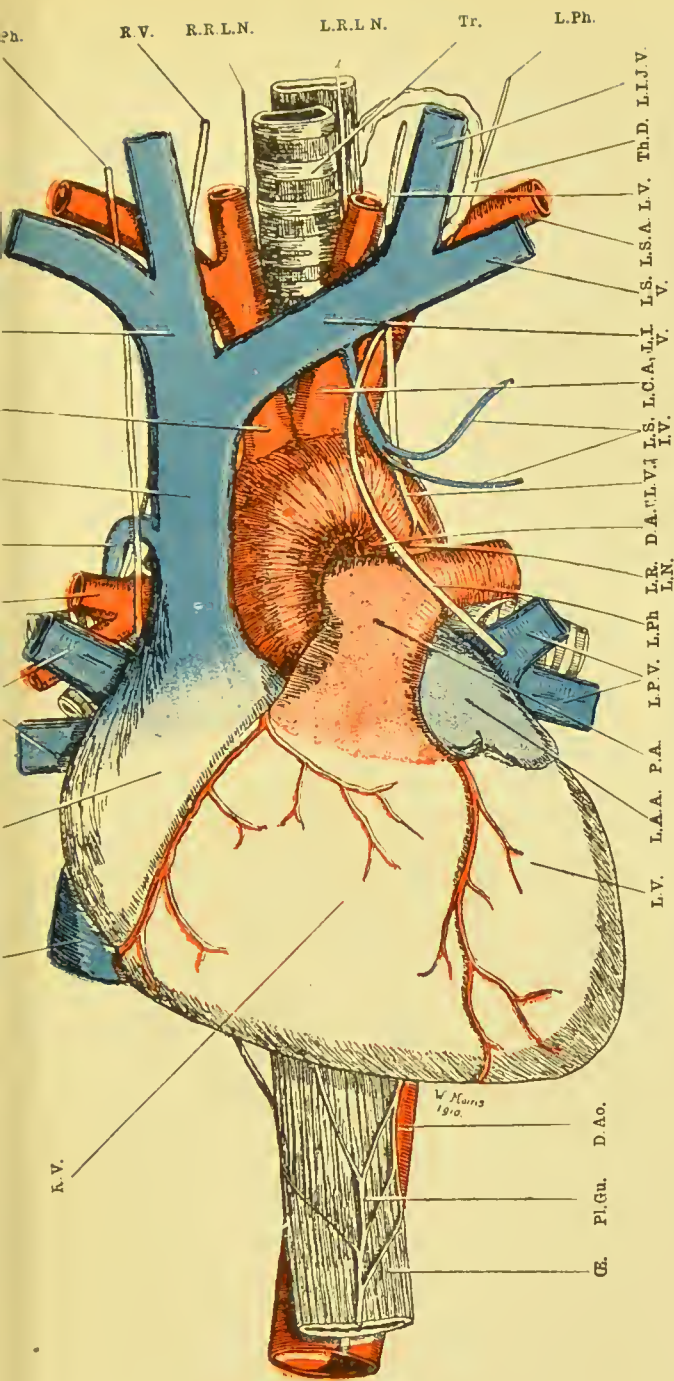


FIG. 217.—THE HEART AND GREAT VESSELS FROM IN FRONT.

R.R.L.N. Right Recurrent Laryngeal Nerve. *L.R.L.N.* Left Recurrent Laryngeal Nerve. *R.V.* Right Vagus. *L.V.* Left Vagus. *R.Ph.* Right Phrenic Nerve. *L.Ph.* Left Phrenic Nerve. *R.I.V.* Right Innominate Vein. *L.I.V.* Left Innominate Vein. *I.A.* Innominate Artery. *S.V.C.* Superior Vena Cava. *V.A.M.* Vena Azygos Major. *P.A.* Pulmonary Artery. *R.P.V.* Right Pulmonary Veins. *L.P.V.* Left Pulmonary Veins. *R.A.* Right Auricle. *R.V.* Right Ventricle. *L.V.* Left Ventricle. *Tr.* Trachea. *Th.D.* Thoracic Duct. *L.S.A.* Left Subclavian Artery. *L.S.V.* Left Subclavian Vein. *L.C.A.* Left Carotid Artery. *L.S.I.V.* Left Superior Intercostal Vein. *D.A.* Ductus Arteriosus. *L.A.A.* Left Auricular Appendage. *D.Ao.* Descending Thoracic Aorta. *Pl.Gu.* Plexus Gulæ. *Es.* Esophagus.

examined, a fine nerve plexus, the *superficial cardiac plexus* [p. cardiacus], will be seen. The easiest way to expose the plexus is to follow down the two small nerves which cross the arch of the aorta between the phrenic and vagus nerves. In following the various nerve filaments forming the plexus a view will be obtained high up in the concavity of the arch of the bifurcation of the trachea.

An attempt should now be made to expose the *deep cardiac plexus* [p. cardiacus profundus]. Divide the arch of the aorta just before the innominate artery is given off. The arch may now be turned upwards and to the left, but great care must be exercised in this procedure in order to save the fine nerve filaments which form the plexus on the anterior surface of the trachea immediately above its bifurcation and behind the aortic arch. From this plexus it may be possible to trace branches to the heart and also to the anterior pulmonary plexuses.

The Trachea.—In the previous dissection the student cannot have failed to notice the trachea, which, situated in the median line, lies in front of the bodies of the first four thoracic vertebræ. It is readily distinguished by the transverse bars of cartilage and by its characteristic resilience to the touch. That portion of the trachea within the thorax alone concerns the dissector at this stage. It extends from the upper aperture of the thorax to the lower border of the 4th thoracic vertebra, at which level it divides into the right and left bronchi. The right bronchus has slightly the larger calibre and is more in a line with the trachea than is the left, since the trachea deviates a little to the right before it divides. For these two reasons a foreign body which has entered the trachea is more prone to travel along the right bronchus than along the left. In front of the trachea are the superficial and deep cardiac plexuses, the arch of the aorta, the innominate and left common carotid arteries, the left innominate vein, and the inferior thyroid veins, which latter descend from the thyroid body to open into the left

innominate vein. To the right of the trachea lie the innominate artery above, the right vagus, pleura and vena azygos major below. To the left are the left common carotid artery and the left recurrent laryngeal nerve. Behind, as already mentioned, are the upper four thoracic vertebræ, while posteriorly and to the left lies the œsophagus (see Fig. 216). It is in the angle between the trachea and œsophagus that the left recurrent laryngeal nerve runs upwards. The region of the bifurcation [bifurcatio-tracheæ] may now be carefully dissected, and the bronchi traced in the direction of the root of the lung. In doing this a number of lymphatic nodes will be met. They are grouped along the lateral aspect of the bronchi as well as between the two divergent bronchi. They are continuous above with the lymphatic nodes of the superior mediastinum, below with those at the root of the lung, and their enlargement may cause pressure symptoms on the bronchi, œsophagus, and recurrent laryngeal nerve.

The left recurrent laryngeal nerve should now be followed from its origin to the point where it leaves the thorax to enter the neck. It may be seen to furnish a few fine twigs to the adjacent deep cardiac plexus.

That portion of the *œsophagus* which lies in the superior mediastinum should next be examined. It lies behind the trachea, although a small portion may be seen to the left of that structure, since it does not adhere to the median plane as closely as does the trachea, but inclines to the left. It lies in front of the bodies of the upper thoracic vertebræ, and the prevertebral muscular system here represented by the longus colli muscle. Further, the œsophagus is separated from these parts by some loose areolar tissue in which, passing obliquely upwards and to the left, lies the thoracic duct. By the time the duct has reached the level of the third thoracic vertebra it is lying distinctly to the left side of the œsophagus (see Fig. 216, C.).

In front of the œsophagus are, in addition to the trachea, the left recurrent laryngeal nerve, the arch of the aorta, the

left common carotid artery and the left innominate vein. To its left side are the arch of the aorta, and above that the left subclavian artery with the thoracic duct intervening. It is here that the duct was picked up through an incision in the pleura made just behind the subclavian artery.

To the right is the trachea, and in some cases the right pleura (see Fig. 215). With the examination of the œso-

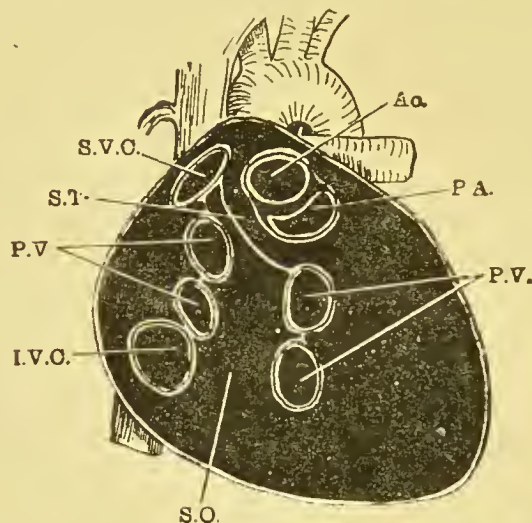


FIG. 218.—DIAGRAM OF THE PERICARDIUM LAID OPEN AND THE HEART REMOVED TO SHOW THE REFLEXIONS OF THE PARIETAL ON TO THE VISCERAL PERICARDIUM.

Ao. Aorta. *P.A.* Pulmonary Artery. *S.V.C.* Superior Vena Cava. *S.T^r.* Sinus Transversus. *P.V.* Pulmonary Veins. *I.V.C.* Inferior Vena Cava. *S.O.* Sinus Obliquus.

phagus the study of the thoracic viscera ends. The viscera may now be removed, but in doing so the opportunity should be taken of revising the knowledge previously obtained regarding the relations of the various parts. It may also now be easier to trace certain of the branches of the vessels and nerves to their destination.

Begin by removing the heart, and in doing so cut the vessels midway between the pericardial wall and the heart in

the following order—pulmonary artery, ascending aorta, superior vena cava, inferior cava, pulmonary veins. The fact that the veins are only covered anteriorly and laterally by the serous pericardium makes it difficult to isolate them, and so divide them cleanly. On removing the heart a good view will be obtained of the way in which the serous pericardium is reflected around the vessels and of the boundaries of the transverse and oblique sinuses.

If it was not possible to open and explore the left auricle of the heart before, it should be done now (see p. 23).

The pericardium should be altogether removed now. Since the arch of the aorta and the roots of the lungs are divided, there is nothing except cellular tissue and its attachment to the diaphragm to keep it in position. It is advisable to cut round that part which is firmly attached to the diaphragm, and so leave it, removing the rest.

The pericardium having been removed, the continuity of the structures passing between the superior and posterior mediastina should be noticed, the whole intrathoracic course of the œsophagus and thoracic duct being specially important.

In the case of the œsophagus, notice that it is at or very near the mid line of the body opposite the fifth thoracic vertebra, but above and below that point it lies to the left. The point at which the tube passes behind the left bronchus is an important one, because here it is often somewhat constricted, and it is said that a little extra pressure in passing an œsophageal bougie may be needed here.

It should be noticed too that, whereas the trachea is only in contact with the right lung and pleura, the œsophagus touches both the right and left. This is easily explained on looking at the section (Fig. 216), which shows how much narrower the superior mediastinum is behind than in front.

The change of position which the thoracic duct undergoes with regard to the œsophagus, about the level of the fourth thoracic vertebra, should be carefully noted. Below that

level the duct lies behind the œsophagus, but at this point it passes to the left and gradually leaves the œsophagus to accompany the left subclavian artery into the neck. A careful look-out should be kept for the *left broncho-mediastinal*

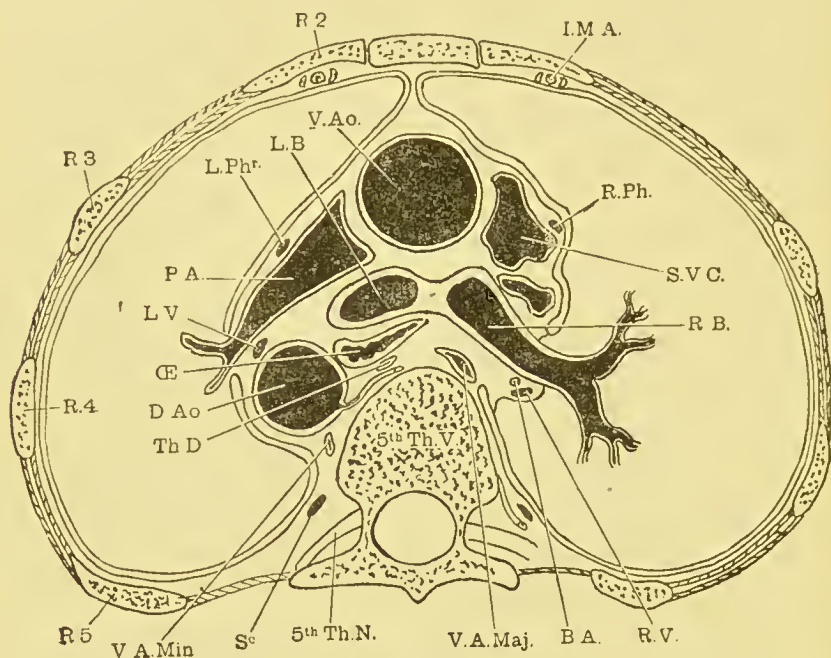


FIG. 219.—SECTION THROUGH THE LOWER PART OF THE SECOND COSTAL CARTILAGE IN FRONT AND THE FIFTH THORACIC VERTEBRA BEHIND.

I.M.A. Internal Mammary Artery. *V.Ao.* Ascending Aorta. *D.Ao.* Descending Thoracic Aorta. *L.Br.* Left Bronchus. *R.Br.* Right Bronchus. *L.Ph.* Left Phrenic Nerve. *R.Ph.* Right Phrenic Nerve. *S.V.C.* Superior Vena Cava. *P.A.* Pulmonary Artery (in front of the Right Bronchus another branch of this is seen). *L.V.* Left Vagus. *R.V.* Right Vagus. *C.* œsophagus. *Th.D.* Thoracic Duct. *V.A.Maj.* Vena Azygos Major. *V.A.Min.* Vena Azygos Minor. *B.A.* Bronchial Artery. *S.* Sympathetic.

duct, which is often a tributary of the thoracic duct, though it is not usually found by students.

If not already dissected, the present will be a convenient time to trace the vagi into and through the plexus gulæ.

The openings in the diaphragm for the œsophagus and for the descending thoracic aorta may also be now studied more easily in detail. Passing through the œsophageal aperture, in addition to that tube will be seen the vagi and fine branches of an artery with accompanying veins, offshoots from the coronary vessels of the abdomen. Through the aortic orifice pass the vena azygos major and the thoracic duct. A number of lymph nodes will also be seen in the loose areolar tissue around the structures lying in the posterior mediastinum. It is along this series of lymphatic vessels and nodes that certain diseases pass from the thorax to the abdomen or *vice versa*. A finger may now be passed along the line of reflexion of the parietal pleura and pericardium on to the diaphragm, and the relation of this line to the surface of the body carefully noted.

The parietal pleura should next be stripped from the lower part of the posterior thoracic wall from the mediastinum outward. A more perfect view will thus be obtained of the *sympathetic cord and ganglia*, and the course of the *great splanchnic nerve* should be traced to where it leaves the thorax by piercing the crus of the diaphragm. The *small splanchnic nerve* lies external to the great, and usually comes from the ninth and tenth ganglia, while occasionally a *third splanchnic nerve* from the lowest ganglion is found (see Fig. 206, p. 37).

One or more intercostal spaces may now be selected, and the intercostal nerve and vessels within the posterior part of the space examined from within the thorax. The vessels and nerves both pass outwards behind the sympathetic cord to obtain the shelter of the subcostal groove of the rib. The vein and artery lie at a slightly higher level than the nerve. One or two small nerves, passing between the intercostal nerve and the adjacent sympathetic ganglion, should be looked for; they are known as the *rami communicantes*, and are classified into white and grey in accordance with the greater or smaller amount of medullary

sheath. White rami come from all the thoracic nerves except the first, and are to be regarded as conveying fibres from the intercostal nerve to the ganglion, while the grey rami run from the ganglion to the nerve. The intercostal nerve traced inward will be seen in the intervertebral foramen to be the larger of the two divisions into which the spinal nerve divides. The other division—the posterior primary—passes directly backwards close to the side of the arch of the vertebra, and is dissected with the muscles of the back. Traced outwards the intercostal nerve with the corresponding vessels passes behind the internal intercostal muscle to gain the interval between that muscle and the external intercostal.

The sternum below the 1st costal cartilages with its associated cartilages may now be removed and placed aside for future examination.

ARTICULATIONS OF THE THORAX

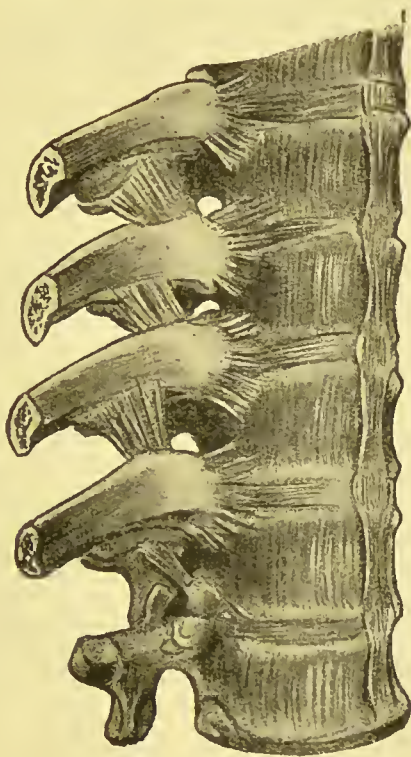
Three or four of the middle thoracic vertebræ with the corresponding ribs may now be removed. The piece thus separated should be used for the demonstration of the articulations and ligaments. Begin by cleaning the ligamentous structures binding the vertebræ together and the ribs to the vertebræ.

The *anterior common ligament* [lig. longitudinale anterius] consists of fibres passing vertically down in front of the median parts of the bodies of the vertebræ.

The *intervertebral disc* [fibro-cartilago intervertebralis] in section shows a series of concentric rings formed by alternate layers of fibrous tissue and fibro-cartilage. Near the centre of these is the *nucleus pulposus*, which is very elastic and expands above the level of the rest of the section.

If the student now turns to the side of the vertebral column he will see that the ribs are here articulated to the column, each by two articulations, the anterior one (costo-

central) to the bodies of the vertebræ and the intervertebral discs, the posterior one (costo-transverse) to the transverse process of a vertebra. The ligament surrounding these joints is in both cases known as the capsular ligament. The anterior portion of the costo-central capsule is strong, and consists of fibres which radiate from the head of the rib,



F.C.C.

FIG. 220.—THE VERTEBRO-COSTAL ARTICULATIONS FROM IN FRONT SHOWING THE STELLATE AND SUPERIOR COSTO-TRANSVERSE LIGAMENTS.

being in consequence known as the *stellate ligament* [lig. capituli costæ radiatum] (see Fig. 221, A.C.C.L.).

The capsular ligament of the costo-transverse joint is supported on the inside and outside by accessory ligamentous bands, the *medial* and *lateral costo-transverse ligaments* [lig. costo-transversaria]. A third accessory ligament, known

as the *superior costo-transverse ligament* [lig. colli costæ], descends from the transverse process of a vertebra to the neck of the rib in the series immediately below.

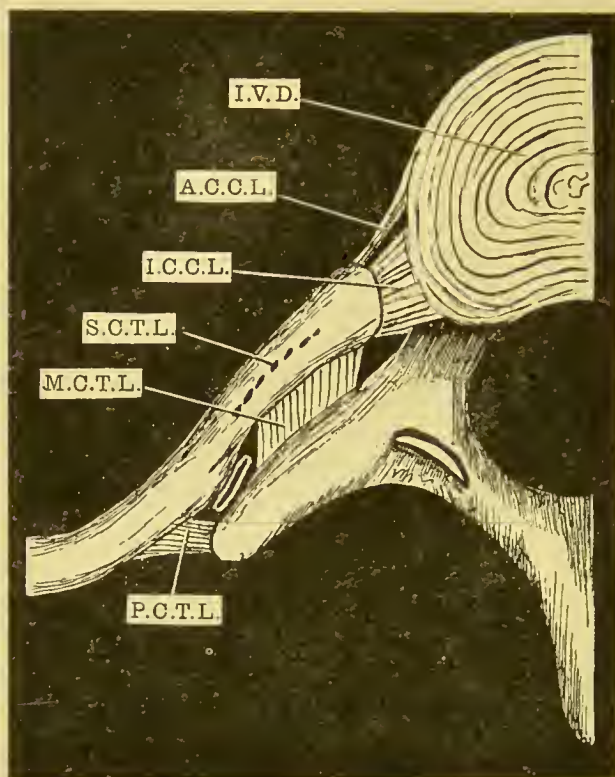


FIG. 221.—DIAGRAM OF THE WAY IN WHICH A RIB IS FASTENED TO THE SPINAL COLUMN.

I.V.D. Intervertebral Disc. *A.C.C.L.* Anterior Costo-central (Stellate) Ligament. *I.C.C.L.* Intra-articular Costo-central Ligament. *S.C.T.L.* Superior Costo-transverse Ligament. *M.C.T.L.* Medial Costo-transverse Ligament. *P.C.T.L.* Lateral (Posterior) Costo-transverse Ligament.

Having recognised these various ligaments, open first the costo-transverse joint and then the costo-central. Both joints probably belong to the arthrodial or gliding variety, although the articulations of the heads of the ribs are sometimes spoken

of as condylarthroses. It should be further noted that the heads of most of the ribs articulate with adjacent parts of two vertebræ and the disc between, while the synovial cavity of the joint is divided by an *intra-articular ligament* passing from the disc to a ridge separating the two articular surfaces on the head of the rib. It might be noted that, if we use the size of the facets as our criterion, a rib articulates chiefly with the vertebra corresponding to it in number, but slightly with the vertebra immediately above it in the series.

Now turn to the part previously set aside for the study of the costal cartilages and sternum. Traced forwards it will be seen that the ribs are directly continuous with the costal cartilages, which, except in the case of the last two, in their turn articulate with the sternum or with each other. Each of these articulations must be examined in turn. The first costal cartilage is directly attached to the manubrium sterni without any synovial cavity intervening. It usually ossifies during middle life. The costal cartilages, from the 2nd to the 7th inclusive, have distinct synovial cavities at their articulation with the sternum, while in the 2nd the synovial cavity is double, being divided by an intra-articular ligament proceeding from the cartilage to the sternum. The synovial cavity is surrounded in each case by a more or less well-defined capsule. The 8th, 9th, and 10th costal cartilages are continuous anteriorly with each other and with the lower border of the 7th. Between certain costal cartilages, usually from the 5th or 6th to the 9th, small *interchondral articulations* are formed, each possessing a small, slit-like synovial cavity. The 11th and 12th costal cartilages end free anteriorly.

The sternum in adult age consists of three pieces, a manubrium articulating with the 1st and the upper part of the 2nd costal cartilages, a gladiolus [corpus sterni] articulating with the lower part of the 2nd, the 3rd, 4th, 5th, 6th, and upper part of the 7th costal cartilages, and an ensiform

cartilage [processus xiphoideus] articulating with the lower part of the 7th rib cartilage.

Between the three parts up to late middle age is situated a fibro-cartilaginous disc. The disc between the gladiolus and ensiform cartilage ossifies about this period, but the disc between the manubrium and gladiolus often remains unossified even in advanced age.

THE ABDOMEN

DURING the first few days, when the body is on its face, the dissectors of the abdomen are usually without work. This, however, need not necessarily be the case, for a little mutual arrangement with the dissectors of the back muscles will enable them to dissect the loin region as soon as the latissimus dorsi has been cleaned and examined. This dissection, which is practically the exposure of the lower pole of the kidney from behind, is a very important piece of work, and seldom has sufficient attention paid to it.

THE ILIO-COSTAL REGION

The ilio-costal region is that portion of the posterior abdominal wall which is bounded above by the last rib and below by the iliac crest. The dissector of the upper extremity will have already removed the skin from this region, found the subcutaneous vessels and nerves, and cleaned the latissimus dorsi muscle.

The posterior border of the *external oblique muscle* will have been exposed. The surface of this muscle should now be cleaned, a sharp look-out being kept for any cutaneous nerves appearing between the digitations of the muscle—the *lateral cutaneous branches of the lower intercostal nerves*. The muscle can be readily recognised by the forward and downward direction of its fibres from the lower ribs to the iliac crest.

Between the outer border of the latissimus dorsi and the posterior border of the external oblique a small triangular area called *Petit's triangle* [trigonum lumbale] should be

looked for. Its base is formed by the iliac crest, its floor by the internal oblique muscle, the fibres of which run parallel to those of the latissimus dorsi. The abdominal wall is

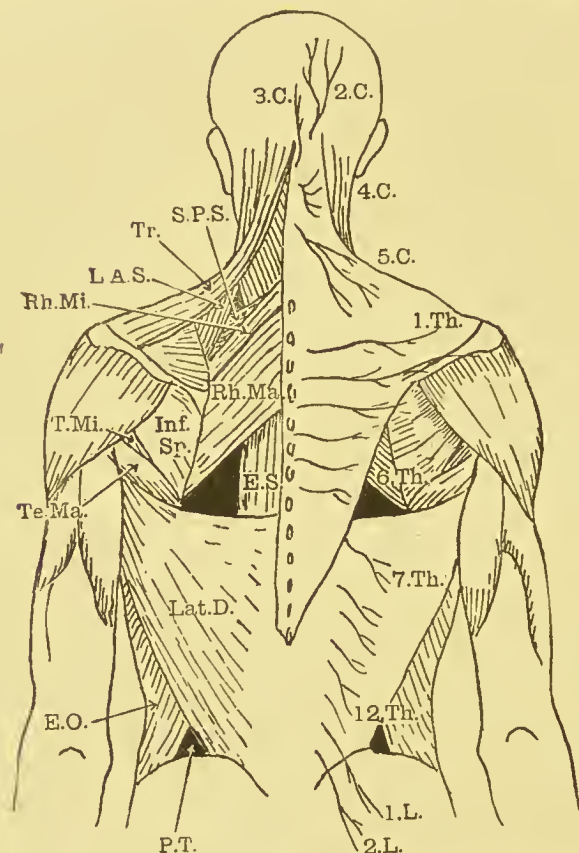


FIG. 222.—DISSECTION OF THE SUPERFICIAL MUSCLES AND NERVES OF THE BACK.

E.O. External Oblique. *Lat.D.* Latissimus Dorsi. *P.T.* Petit's Triangle. *E.S.* Erector Spinae.

(The rest of the lettering is explained on p. 241.)

weak at this triangular area, which in consequence is occasionally the site of a lumbar hernia.

The outer border of the erector spinæ muscle should now be identified by pressure with the fingers. An incision

should next be made, beginning at the angle between this muscle and the last rib, and extending downwards and forwards for four or five inches in the direction of the fibres of the external oblique. The incision should be carefully made so that only the latissimus dorsi and external oblique muscles are divided. Unless the greatest care is exercised, particularly at the upper end of the incision, it will be found that a very thin sheet of muscle, the *serratus posticus inferior*, is also divided. It is helpful to remember that the outer border of this latter muscle runs upwards and outwards from the second lumbar spine to the last rib. Any nerves which may happen to lie in the line of the incision should be dissected aside.

Now retract upwards and downwards the latissimus dorsi and external oblique muscles, a procedure which will expose a larger area of the internal oblique, a small portion of the serratus posticus inferior, and between the two the *lumbar fascia*, which extends inward to fuse with the origin of the serratus posticus inferior and latissimus dorsi and from which the internal oblique may be seen to arise.

The latter muscle should now be divided in the same line as were the latissimus dorsi and external oblique, and retracted upwards and downwards, detaching the muscle as much as is necessary from the lumbar fascia and sparing all vessels and nerves. This dissection will bring into view the transversalis muscle, which derives its name from the direction of its fibres. This muscle will be seen to be the forward continuation of the lumbar fascia. Between the transversalis and the internal oblique in this dissection three important nerves will be found—the *last thoracic (subcostal)* running nearly parallel with and below the last rib; the *ilio-hypogastric* and *ilio-inguinal* at a slightly lower level. The dissector is often guided to these nerves by one or other of their branches met in reflecting the external oblique.

The lumbar fascia should now be traced inward and its disposition and attachments demonstrated. In this the

dissectors of the abdomen and head and neck should work together. Identify again the outer border of the erector spinæ. Make a vertical incision two inches in length and

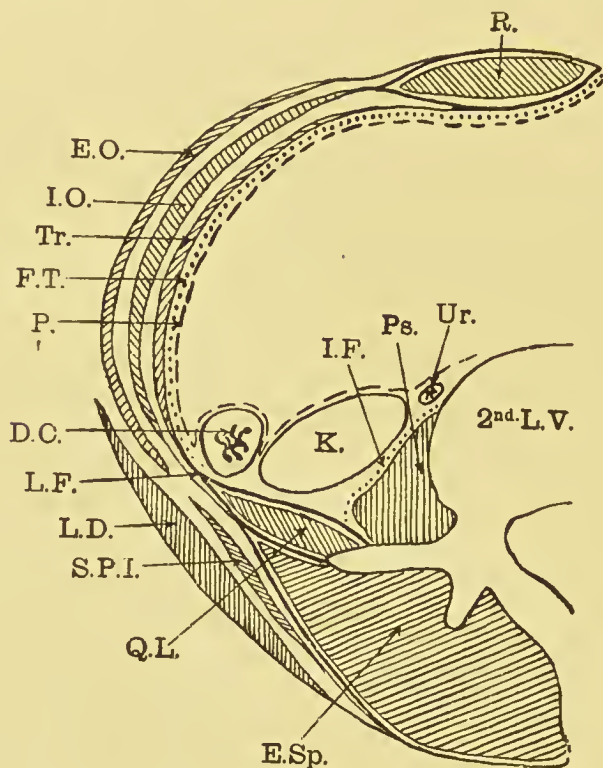


FIG. 223 —SECTION OF THE ABDOMINAL WALL THROUGH THE LOWER PART OF THE SECOND LUMBAR VERTEBRA.

R. Rectus. *E.O.* External Oblique. *I.O.* Internal Oblique. *Tr.* Transversalis. *F.T.* Fascia Transversalis. *P.* Peritoneum. *D.C.* Descending Colon. *L.F.* Lumbar Fascia. *L.D.* Latissimus Dorsi. *S.P.I.* Serratus Posticus Inferior. *Q.L.* Quadratus Lumborum. *E.Sp.* Erector Spinæ. *K.* Kidney. *I.F.* Iliac Fascia forming Psoas Sheath. *Ps.* Psoas. *Ur.* Ureter.

one inch internal to this outer border through the origin of the latissimus dorsi and serratus posticus inferior. The erector spinæ will be thus exposed and may be pushed inward by applying the handle of the scalpel to its outer

border. This procedure will show that in front of the erector spinæ there exists another strong fascia, the middle layer of lumbar fascia. This second fascia should now be divided in the same vertical line as was the first, when the *quadratus lumborum* muscle will come into view; while if it, in its turn, is pushed inward in the same way as was the erector spinæ, a third fascia will appear. If these three fasciæ be now traced outward, it will be found that the posterior and middle unite with each other at the outer border of the erector spinæ and with the anterior at the outer border of the *quadratus lumborum*. The lumbar fascia may therefore be regarded as constituted of three lamellæ—anterior, middle, and posterior. Outward beyond their fusion they are continued into the internal oblique and transversalis muscles; internally they are attached respectively to the front of the transverse processes, the tips of the transverse process, and to the tips of the spines of the lumbar vertebræ; the last two attachments can be easily seen, while the first can at this stage be only indefinitely felt.

Now divide the lumbar fascia and transversalis muscle in the same line as were divided the *latissimus dorsi*, the external and internal oblique muscles. This incision necessarily divides a thin underlying fascia—the fascia transversalis, which is partly the sheath of the transversalis muscle, partly condensed extra-peritoneal tissue, and altogether negligible for practical purposes.

Reflect the lumbar fascia up and down, and, if it can be seen, divide the fascia transversalis by which the scalpel will enter the extra-peritoneal tissue, which contains a variable amount of fat and is traversed in this region by the three nerves mentioned above before they come to lie between the transversalis and internal oblique muscles.

Search should be made by the finger in this fat for the lower pole of the kidney, and immediately to the outer side of this the ascending colon on the right side, the descending colon on the left side, may be easily felt, and can be pulled

up into the incision. The three nerves already mentioned (the subcostal, ilio-hypogastric, and ilio-inguinal) can also be further traced upward and inward in the extra-peritoneal

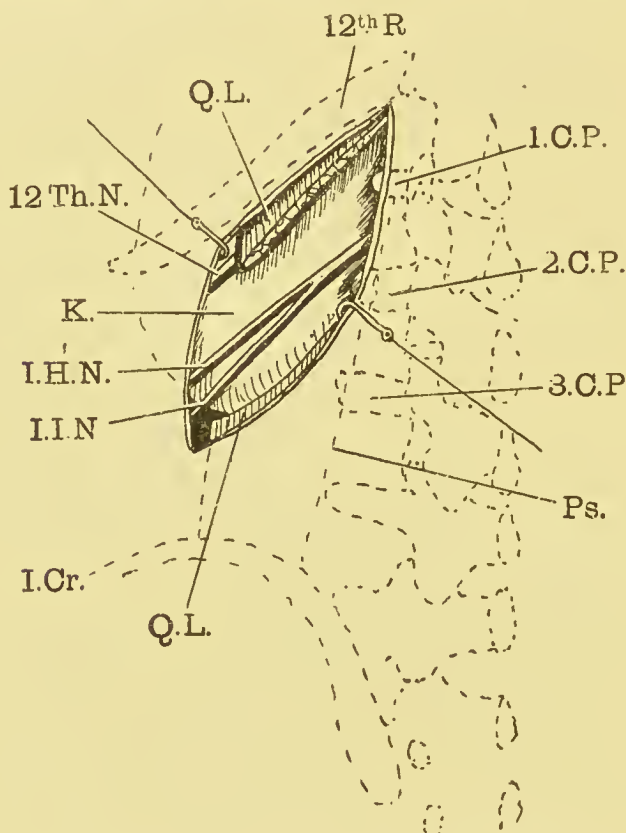


FIG. 224 —DISSECTION OF THE LEFT KIDNEY FROM BEHIND.

12th R. Twelfth Rib. Q.L. Quadratus Lumborum. 12th Th.N. Twelfth Thoracic Nerve. K. Kidney. I.H.N. Ilio-hypogastric Nerve. I.I.N. Ilio-inguinal Nerve. I.Cr. Iliac Crest. Ps. Line of Outer Edge of Psoas. 1, 2, 3 C.P. The Upper Three Costal or Transverse Processes of the Lumbar Vertebrae.

fatty tissue toward the spine. They are intimate posterior relations of both the kidney and colon. The fat often forms a compact mass—the *pararenal body*. By carefully cutting through the fat a strong layer of fascia will be met, the

posterior layer of Gerota's fascia. This should next be divided when the *perirenal fatty tissue* will be encountered in which the finger can readily feel the lower pole and outer border of the kidney. In the ilio-costal region the colon and a considerable portion of the kidney will be seen to lie upon the transversalis muscle; the rest of the kidney is concealed by the quadratus lumborum. The line of the colon should be carefully noted; it is half an inch internal to a vertical line drawn from the mid point of the iliac crest, and, below the kidney, occupies the angle between the psoas and quadratus lumborum muscles.

The parts should now be replaced and stitched up layer by layer.

THE ANTERIOR ABDOMINAL WALL

SUPERFICIAL ANATOMY.—Identify in the middle line the *ensiform cartilage*, the *umbilicus*, and the *symphysis pubis*. It will be noticed in identifying the first of these that the ensiform cartilage is on a deeper plane than the front of the gladiolus, and that at the *gladiolo-ensiform junction* a distinct depression is felt. This, in popular language, is known as the "pit of the stomach."

By passing the finger outwards from the symphysis pubis for one inch the *spine of the pubis* will be localised (see Lower Extremity, p. 368, vol. i.), and between the two is the *pubic crest*.

Directly above the pubic spine is the *external abdominal ring* [annulus inguinalis subcutaneus], which is larger in the male than in the female, and in the former may easily be explored in the living subject by invaginating the scrotum and passing the index finger up along the spermatic cord.

Between the anterior superior spine and the spine of the pubis the depression caused by the *ligament of Poupart* [lig. inguinale] should be noted.

In females who have borne children the lower part of the

skin of the abdomen often shows several more or less vertical white lines—the *lineae gravidarum*.

The *umbilicus* is not constant in position, but is usually just above a line joining the highest points of the two iliac crests and a little below the mid point between the infra-sternal notch and the top of the symphysis pubis. It is often slightly protuberant in the child, but in the adult is

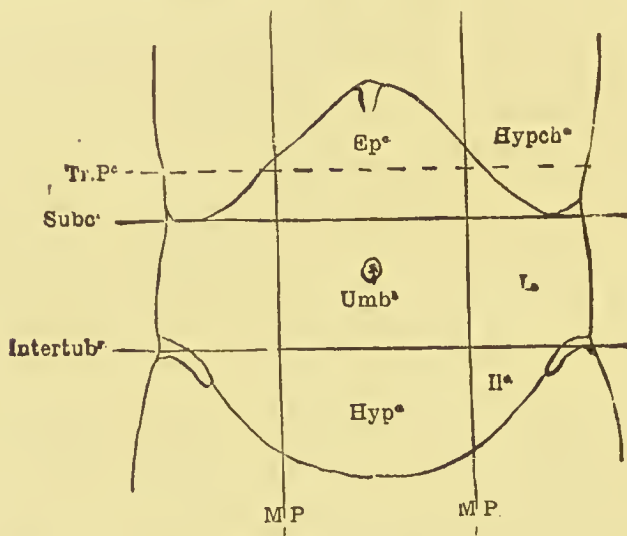


FIG. 225.—DIAGRAM OF THE ANTERIOR ABDOMINAL WALL TO SHOW THE ARTIFICIAL MARKINGS.

Tr.Pc. Transpyloric Line. *Subc*^l. Subcostal. *Intertub*^r. Intertubercular. *M.P.* Mid-pyloric Lines. *Ep*^c. Epigastric Region. *Umb*^l. Umbilical Region. *Hyp*^c. Hypogastric Region. *Hypch*^c. Hypochondriac Region. *L*. Lumbar Region. *Il*^c. Iliac Region.

usually dragged downwards and backwards, and is distinctly depressed.

In thin muscular subjects a crescentic line, with its convexity outwards, is often seen on either side, running vertically upwards about $2\frac{1}{2}$ inches from the linea alba. It is known as the *linea semilunaris*.

The lower margin of the thorax and the iliac crest should be carefully palpated, and the following lines constructed by

the use of a blue pencil, viz. the subcostal, the intertubercular, and the right and left mid-Poupart. The first two are horizontal; the last two are vertical. The *subcostal line* passes through the most dependent points of the lower costal margin seen from the front, points formed, as a rule, by the tenth costal cartilages. The *intertubercular line* passes between the tubercles on the iliac crest two to three inches behind the anterior superior iliac spine.

The *mid-Poupart lines* pass vertically upward through the mid points of Poupart's ligament. By these lines the following nine regions are marked out: In the middle, from above downwards, the *epigastric*, *umbilical*, and *hypogastric*, and on each side the *hypochondriac*, *lumbar*, and *iliac*. Another line should now be drawn—the *transpyloric line of Addison*; it is a horizontal line passing through the mid point of a line from the upper border of the manubrium sterni to the upper border of the symphysis pubis. It usually passes through the pylorus of the stomach and just above the hila of the kidneys; it corresponds in level to the first lumbar vertebra and lies one to two inches above the subcostal line (see Fig. 225).

It is convenient to bear in mind that, while the transpyloric line corresponds to the first lumbar vertebra, the subcostal is opposite the third, and the intertubercular opposite the fifth.

DISSECTION OF THE ANTERIOR ABDOMINAL WALL

The skin must now be reflected. To do this make a median incision from the ensiform cartilage to the pubis. This incision should pass on each side of the umbilicus, which should be retained *in situ*. Next make two other incisions one horizontal at the level of the gladiolo-ensiform junction, the other along Poupart's ligament. The skin should now be reflected outwards in one sheet, the markings of the subcostal, mid-Poupart, and transpyloric lines being preserved,

and, if necessary, retraced. The superficial fascia now exposed is often laden with fat, a condition which makes the discovery of the subcutaneous nerves somewhat difficult. A median vertical incision should be made through the superficial fascia down to the thin layer of deep fascia which overlies the aponeurosis of the abdominal muscles. The superficial fascia should then be turned outward as a continuous sheet, a sharp look-out being kept for the subcutaneous nerves, which will be seen to pierce the aponeurosis at variable distances from the mid line, and enter the superficial fascia. These are the *anterior cutaneous nerves* of the abdomen, and are derived from the last thoracic and the lower five intercostal nerves. The branch from the 10th intercostal nerve is distributed at the level of the umbilicus.

Two other nerves are practically constant in position and therefore easily found; one—the *hypogastric branch of the ilio-hypogastric nerve*—enters the superficial fascia about an inch above the external abdominal ring; the other—the *ilio-inguinal*—comes out of the external abdominal ring just external to the spermatic cord, and is distributed to the scrotum (or labium) and thigh (see p. 371, vol. i.). The nerves being found should be traced as far as possible into the superficial fascia and then divided, so that the fascia may be reflected still further. As the lateral portion of the abdominal wall is reached, another series of nerves will be found emerging between the serrations of the external oblique muscle. These are the *lateral cutaneous branches of the intercostal nerves*. These nerves should be treated in the same way as were the others.

The lateral cutaneous branch of the twelfth thoracic nerve crosses the iliac crest about an inch behind the anterior superior spine, while the iliac branch of the ilio-hypogastric also crosses at the site of the tubercle of the crest; they are noticed in the dissection of the buttock (see p. 343, vol. i.).

The *fascia of Scarpa*, or deeper layer of the superficial fascia, in the lower part of the abdomen, contains less fat

than does the superficial layer or *fascia of Camper*; the distinction between these two layers, however, is quite arbitrary.

The underlying muscle—the *external oblique*—must now be cleaned, and its origin from the eight lower ribs exposed. It rises by a series of digitations, one from each rib, external to the angles.

Each digitation lies behind as well as below the one above it. The upper five interdigitate with serrations of the *serratus magnus*; the lower three with those of the *latissimus dorsi*. This part needs careful dissection, as it is here that the lateral cutaneous nerves are found.

The external oblique muscle will be seen to form an aponeurosis, which passes forwards to the *linea alba*, a fibrous band occupying the middle line, and downwards to form the *ligament of Poupart*. Between the pubic symphysis and pubic spine a gap will be found in the aponeurosis—the *external abdominal ring* [*annulus inguinalis subcutaneus*]. The ring is a buttonhole-like slit with its long axis passing upwards and outwards. The margins of the slit are called the *internal* and *external pillars* of the ring. The ring is at present not clearly defined, because from its margins the thin *external spermatic fascia* is prolonged downwards along the spermatic cord.

That portion of the external oblique muscle which lies above a horizontal line through the anterior superior iliac spines should now be detached from the lower eight ribs and from the iliac crest and carefully thrown forwards. It will be found that its aponeurosis can be traced beyond the *linea semilunaris*. In this reflexion several of the intercostal nerves will be met as well as the last thoracic, the ilio-hypogastric and ilio-inguinal nerves. The two latter pierce the internal oblique close to the anterior superior iliac spine, while the last thoracic is found one to two inches above. The branches of these nerves already found will aid the dissector to find their main trunks.

The *internal oblique muscle* is now partly exposed, and

is seen to arise from the anterior two-thirds of the iliac crest and the lumbar fascia, and to pass upwards and forwards to be inserted posteriorly into the lower borders of the lower

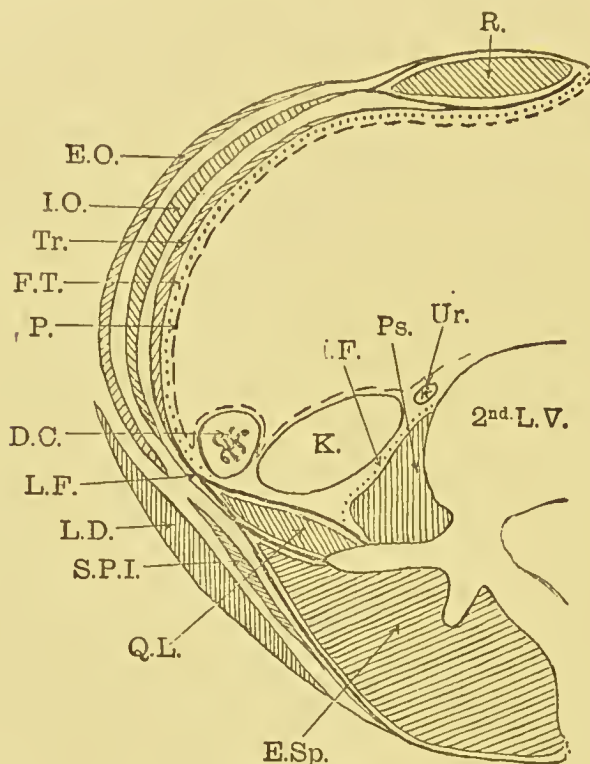


FIG. 226.—SECTION OF THE ABDOMINAL WALL THROUGH THE LOWER PART OF THE SECOND LUMBAR VERTEBRA.

R. Rectus. *E.O.* External Oblique. *I.O.* Internal Oblique. *Tr.* Transversalis. *F.T.* Fascia Transversalis. *P.* Peritoneum. *D.C.* Descending Colon. *L.F.* Lumbar Fascia. *L.D.* Latissimus Dorsi. *S.P.I.* Serratus Posticus Inferior. *Q.L.* Quadratus Lumborum. *E.Sp.* Erector Spinae. *K.* Kidney. *I.F.* Iliac Fascia forming Psoas Sheath. *Ps.* Psoas. *Ur.* Ureter.

six ribs and anteriorly into an aponeurosis, which, at the linea semilunaris, splits into two layers, one of which passes in front and one behind the rectus muscle.

After being cleaned the internal oblique muscle should

be separated from the iliac crest and lumbar fascia and turned forwards to its insertion. This procedure exacts considerable care, otherwise the underlying transversalis muscle will be reflected with it. The internal oblique should be cautiously cut through, and any change in the direction of the fibres noted. A horizontal incision should be made in it, directly inwards from the anterior superior spine, so as to leave that part of the muscle in contact with the inguinal canal for future dissection.

An unnamed arterial branch of the circumflex iliac artery often further serves as a guide, since it ascends between the two muscles from the neighbourhood of the anterior superior iliac spine.

At the linea semilunaris the aponeurosis of the internal oblique splits into two lamellæ, which pass, one in front of and one behind, the rectus.

The *transversalis muscle* [m. transversus abdominis] will be now in part exposed, and can be seen arising from the anterior two-thirds of the iliac crest, the lumbar fascia, and the internal surfaces of the last six ribs; it passes forwards to blend with the posterior lamella of the aponeurosis of the internal oblique, and the horizontal direction of its muscular fibres should be carefully noted. The abdominal wall is thus seen to be muscular at the sides and aponeurotic in front. The fact of the muscular fibres passing in different directions adds greatly to its strength.

Make a horizontal incision about three inches long through the transversalis in the region of the flank, but be careful not to cut too deeply. Retract the edges and try to find a delicate membrane lining the deep surface of the muscle; this is the *transversalis fascia*, really the outer part of the extra-peritoneal cellular tissue free from fat.

Deep to it the extra-peritoneal tissue contains scattered flakes of fat, and when these are reached it is a sign that the next cut will open the peritoneal cavity.

THE INGUINAL REGION

The student should now turn his attention to that part of the anterior abdominal wall below the aforesaid horizontal line running inward from the anterior superior iliac spine. On one side the following dissection should be made: Free the external oblique aponeurosis from the underlying internal oblique muscle as far inwards as possible by separating them along the horizontal line, next make an incision from the innermost point thus freed to the inner side of the internal pillar of the external abdominal ring. This triangular portion of the external oblique aponeurosis should be turned downwards and its continuity with Poupart's ligament demonstrated. The latter ligament may now be seen to be attached to the pubic spine and to the inner inch of the ilio-pectineal line, where it forms *Gimbernat's ligament* [lig. lacunare]. Beyond the pubic spine Poupart's ligament can be readily traced for a considerable distance in front of the symphysis and along the pubic arch, while some of the inner fibres of Poupart's and Gimbernat's ligaments are reflected upwards behind the ring as a delicate fibrous sheet and blend with the anterior sheath of the rectus. These fibres, when distinct, are known as the *triangular fascia* [lig. inguinale reflexum].

The lower portion of the internal oblique muscle will now be exposed, and it will be seen that it arises from rather more than the outer half of Poupart's ligament, and passes in an arched manner downwards and inwards to be inserted into the ilio-pectineal line.

Examine the spermatic cord if the subject be a male, and trace it upwards under cover of the internal oblique. In the female the place of the cord is taken by the *round ligament of the uterus*, a delicate fibro-muscular cord, which, after passing out of the external abdominal ring, loses itself in the superficial fascia of the mons Veneris and upper part of the

labium majus. If the internal oblique is now carefully reflected downwards, the transversalis will be exposed, and can be seen to arise from the outer third of Poupart's ligament, and to pass downwards and inwards to fuse with the internal oblique forming the *conjoined tendon* [falx inguinalis], and so to gain an insertion into the ilio-pectineal line. The transversalis is inserted into slightly more of the line than is the internal oblique. Below the lower arched borders of the internal oblique and transversalis muscles, and above

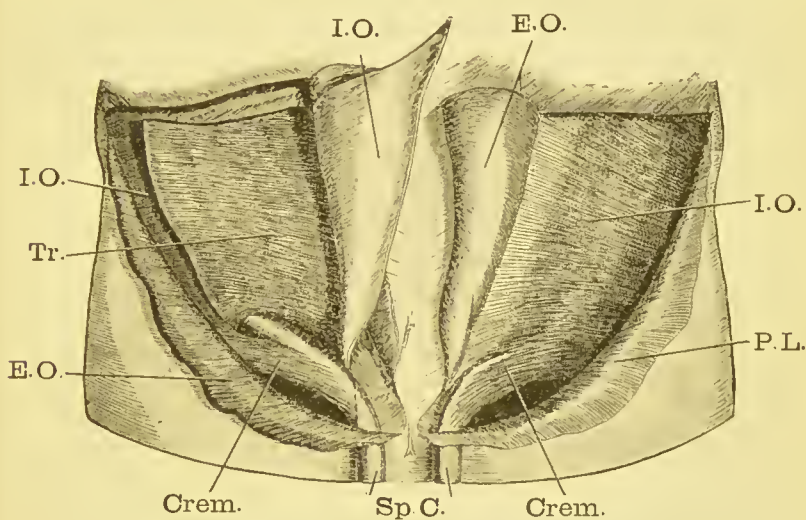


FIG. 227.—DISSECTION OF THE INGUINAL REGION.

E.O. External Oblique. *I.O.* Internal Oblique. *Tr.* Transversalis.
P.L. Poupart's Ligament. *Crem.* Cremaster. *Sp.C.* Spermatic Cord.

Poupart's ligament, the somewhat oval area of the posterior wall of the inguinal canal is formed by the transversalis fascia, which is thicker here than elsewhere. Below the lower border of the transversalis and deep to the internal oblique the fascia is evaginated along the spermatic cord like the finger of a glove, and is known as the *infundibuliform* or *internal spermatic fascia*. The point of evagination is the *internal abdominal ring* [annulus inguinalis abdominalis], and is situated half an inch above Poupart's ligament

midway between the anterior superior spine and the symphysis pubis, and lateral to the deep epigastric artery.

Further, in its course through the inguinal canal from the internal abdominal ring to the external the spermatic cord receives a series of muscular slips, sometimes forming loops, from the internal oblique muscle and Poupart's ligament. These fibres form the *cremaster muscle*, which is supplied by the genito-crural nerve.

The *inguinal canal* will now be seen to be a passage, flattened from before back, beginning at the internal abdominal ring and ending at the external; it is directed downwards, forwards, and inwards, and is $1\frac{1}{2}$ inch in length. Its posterior wall is formed by the fascia transversalis, conjoined tendon, and triangular fascia; its anterior wall by the internal oblique and by the aponeurosis of the external oblique; its floor by Poupart's and Gimbernat's ligaments.

Finally, a very strong tendinous band should be noted lying along the ilio-pectineal line, and passing up along the inner border of the psoas muscle to join Poupart's ligament. It is called the *ligament of Cooper*, and from its strength it is not infrequently serviceable as a structure to which Poupart's ligament can be stitched in the operation for the radical cure of hernia.

The *sheath of the rectus muscle* must now be opened and its contents examined. A vertical incision must be made from the lower border of the thorax to the symphysis pubis, midway between the linea alba and the linea semilunaris. The anterior wall of the sheath must now be reflected inwards and outwards. No difficulty will be met in this procedure except along three transverse lines called the *lineæ transversæ* [inscriptiones tendineæ], where the rectus muscle has tendinous intersections which are fused with the sheath. These lines are situated one about the level of the umbilicus, one at the tip of the ensiform cartilage, and one midway between these two. Occasionally there may be four or more lines, as in the statue of Hercules Farnese. In reflecting the sheath

the anterior cutaneous nerves will be found coming through the rectus muscle after having supplied it.

At the lower end of the sheath, lying immediately in front of the rectus muscle, there is often a small triangular sheet of muscle—the *pyramidalis*—which arises from the pubic crest, and is inserted into the lower inch or so of the linea alba. Entering the deep surface of this muscle will be found a twig of the last thoracic nerve. The *origin of the rectus* is seen when the pyramidalis is turned down; it is by two heads, an inner small one from the anterior pubic ligaments, and an outer, larger, from the crest of the pubis. Its *insertion* is into the superficial surfaces of the 5th, 6th, and 7th costal cartilages and ensiform cartilage.

The rectus muscle should now be separated by means of the handle of the scalpel from the posterior wall of the sheath. This can be accomplished with perfect ease, for there is no union between the tendinous intersections and the posterior wall of the sheath. Lying between the rectus and the posterior wall of the sheath will be found, above, the *superior epigastric vessels*, and, below, the *deep epigastric vessels*. The former enter through the upper aperture, the latter by piercing the posterior wall of the sheath, which wall is thin and fibrous in the lower quarter of the abdomen, because here the aponeuroses of all three flat muscles pass in front of the rectus.

The free edge, where the transversalis and half the internal oblique aponeurosis cease to pass behind, sometimes forms a definite crescentic fold with its concavity downwards, and is known as the *semilunar fold of Douglas* [linea semicircularis]. Often, however, the transition is less abrupt, and two or three indefinite transverse bands are all that can be seen.

Quite low down the conjoined tendon blends with the posterior wall and again thickens it.

Notice that the nerves supplying the rectus enter the posterior wall of the sheath, and that near the costal carti-

lages the fleshy fibres of the transversalis lie behind the rectus muscle. Now look at the *linea alba*, where the two sheaths join, and notice how wide it is above the umbilicus, how narrow below. Notice, too, the firm fibrous ring surrounding the umbilicus [*annulus umbilicalis*], a ring so dense that true umbilical hernia is very rare indeed, and most of the "ruptures" in this region are outside the ring.

THE PENIS AND SCROTUM

SURFACE ANATOMY.—The prepuce should be pulled back, uncovering the *glans penis*, the base of which—the *corona glandis*—is sharply separated from the body of the penis. The downward and forward obliquity of the corona should be noted, also the *frenum preputii*, or fold of skin below the glans, and the *external urinary meatus*. The skin of the penis is thin, free from hair, and but loosely attached to underlying structures. The skin of the scrotum is a little thicker and possessed of spare hairs. A close inspection of the under surface of the penis and scrotum will disclose a median raphe. By deep pressure along the penis it may be possible to discover that it is formed of three rod-like parts, so arranged that two are dorsal and one mesial and ventral. The two former are the *corpora cavernosa*, and end at the corona glandis; the last, the *corpus spongiosum*, is continuous with the glans.

A catheter should now be passed through the external urinary meatus along the urethra to the bladder. In passing the catheter the student should stand to the left of the cadaver. The penis is pulled forward and the point of the catheter passed through the meatus, the catheter being held parallel to Poupart's ligament. The catheter should be allowed to glide by its own weight as far as what will afterwards be found to be the triangular ligament, the handle of the catheter moving inwards until it occupies the middle line. At the triangular ligament a good deal of manipula-

tion is usually required. After the ligament has been passed, the handle of the catheter should be slowly lowered between the thighs, when the instrument will enter the bladder. The skin of the penis should now be fixed by stitching the prepuce to the handle of the catheter.

In formalin-preserved bodies the introduction of the catheter is a very difficult task, and the student must particularly avoid using any force; otherwise, he will make a false passage. If he fail after one or two attempts, the help of the demonstrator should be asked.

DISSECTION OF THE PENIS.—A median incision should now be made on the dorsum of the penis, and the skin carefully reflected to the sides. In the middle line a superficial and deep *dorsal vein* of the penis will usually be seen. On either side of these the *dorsal artery of the penis*, and, still more laterally, the *dorsal nerve of the penis*. These should be traced forwards and backwards. The dorsal veins will be seen to begin at the corona glandis, where they are formed by the union of several small veins, which, beginning on the ventral aspect of the glans, run round the glans to the mid-dorsal line.

In tracing the veins backwards towards the symphysis, a strong band of connective tissue will be met fastening the dorsum of the penis to the anterior abdominal wall; this is the *suspensory ligament of the penis*, and where it is attached the corpora cavernosa will be seen to be bent very sharply on themselves (see Fig. 228).

Clear it away, when the superficial dorsal vein, when it is present, will be seen to divide into two vessels, which run into the superficial external pudic veins.

The deep dorsal vein disappears by passing under the subpubic ligament.

At the root of the penis, on either side, a careful search should be made for small twigs from the ilio-inguinal nerve, and from the superficial and deep external pudic vessels. All the vessels are accompanied by fine lymphatic vessels.

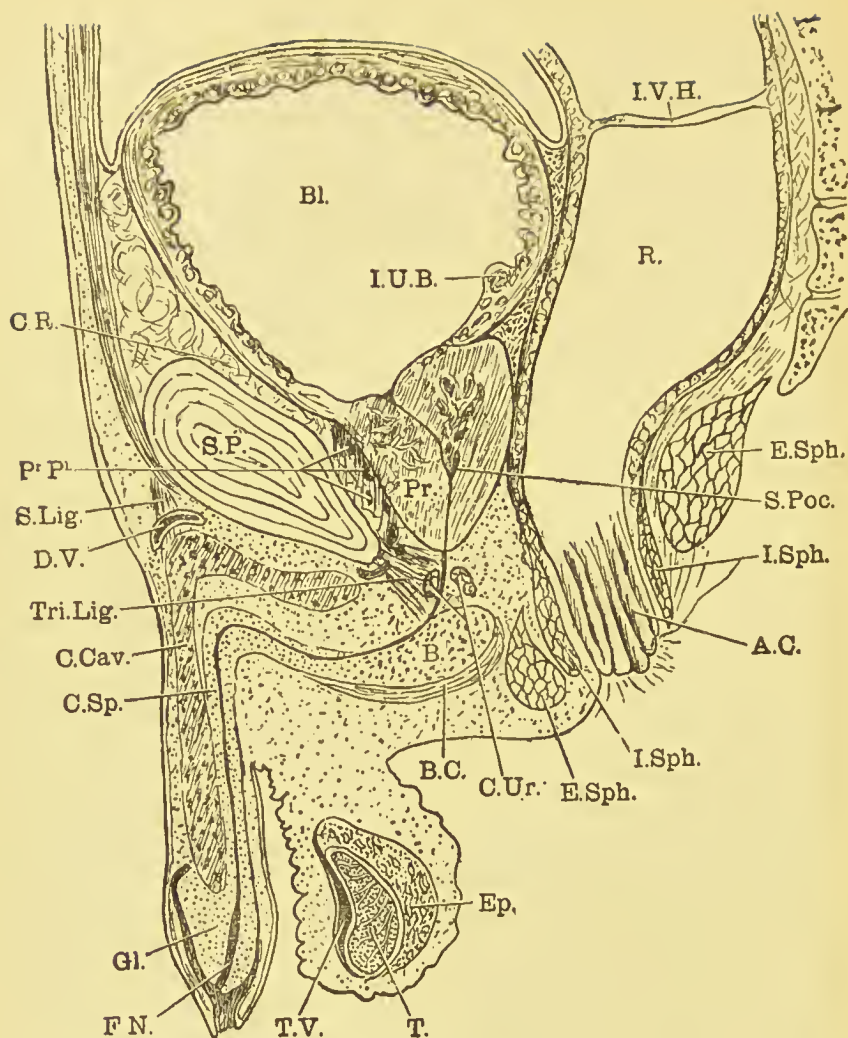


FIG. 228.—MEDIAN SAGITTAL SECTION THROUGH THE MALE PELVIS.

C.R. Cave of Retzius. *S.P.* Symphysis Pubis. *Pr.P^l* Prostatic Plexus. *S.Lig.* Suspensory Ligament of Penis. *D.V.* Dorsal Vein. *Tri.Lig.* Triangular Ligament. *C.Cav.* Corpus Cavernosum. *C.Sp.* Corpus Spongiosum. *Gl.* Glans. *F.N.* Fossa Navicularis. *T.V.* Tunica Vaginalis. *T.* Testis. *Ep.* Epididymis. *Bl.* Bladder. *I.U.B.* Section of Interureteric Bar. *Pr.* Prostate. *B.* Bulb. *B.C.* Bulbo-cavernosus. *C.Ur.* Compressor Urethrae. *E.Sph.* External Sphincter. *I.Sph.* Internal Sphincter. *I.V.H.* Lowest Valve of Houston. *R.* Rectum. *A.C.* Anal Canal. *S.Poc.* Sinus Pocularis.

The loose tissue surrounding the corpora cavernosa and corpus spongiosum should now be removed; the termination of the former at the corona, and the continuity of the latter with the glans being shown.

The catheter should now be withdrawn and two transverse sections made of the penis, one near the scrotum, the other through the middle of the glans. In the first the two corpora cavernosa will be seen to have thick fibrous walls surrounding the cavernous erectile tissue. Where the two

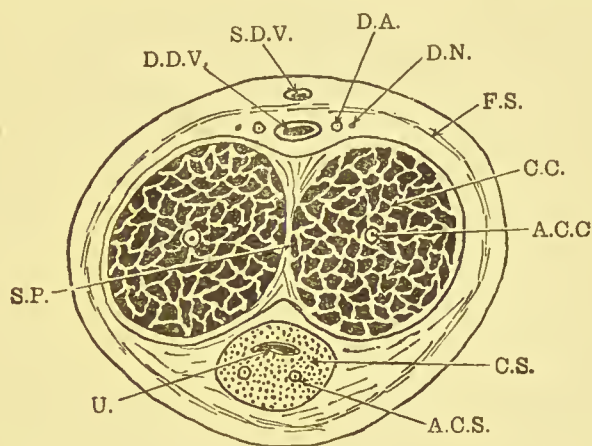


FIG. 229.—TRANSVERSE SECTION THROUGH THE BODY OF THE PENIS.

S.D.V. Superficial Dorsal Vein. *D.D.V.* Deep Dorsal Vein. *D.A.* Dorsal Artery. *D.N.* Dorsal Nerve. *F.S.* Fibro-cellular Sheath. *C.C.* Corpus Cavernosum. *S.P.* Septum Pectiniforme. *C.S.* Corpus Spongiosum. *U.* Urethra. *A.C.S.* Artery of Corpus Spongiosum.

bodies join the fibrous sheath is incomplete, and if a part of one of the corpora cavernosa be removed so that the septum can be looked at from the side, it will show a somewhat comb-like appearance, which earns it the name of the *septum pectiniforme*.

The *corpus spongiosum* has a much less dense sheath, and its erectile tissue is more delicate than that of the corpora cavernosa. Rather nearer its dorsal than its ventral surface, and embedded in it, is the urethra, which is here

a transverse slit, with its dorsal and ventral walls in contact.

In the section through the glans the urethra has usually a \perp -shaped appearance, thus giving greater room for expansion. The expanded part is known as the *fossa navicularis*, but at the meatus it contracts again into a vertical slit, which is the narrowest part of the whole urethra; so that, in a healthy urethra, any instrument which will pass through the meatus will reach the bladder. Now slit up the whole

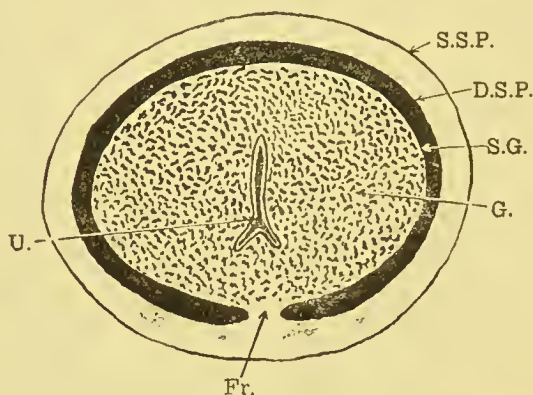


FIG. 230.—SECTION THROUGH THE GLANS PENIS.

S.S.P. Superficial Skin of Prepuce. *D.S.P.* Deep Skin of Prepuce. *S.G.* Skin of Glans. *G.* Glans Penis. *U.* Urethra, here forming the Fossa Navicularis. *Fr.* Frenum Preputii.

length of the urethra from the under surface and notice the smoothness of its walls. In the fossa navicularis look for a delicate crescentic pocket on the roof, with its opening towards the meatus—this is the *lacuna magna* [valvula fossæ navicularis], and sometimes engages the point of a very small catheter; it is usually about an inch from the meatus.

DISSECTION OF THE SCROTUM

The scrotum should now be hooked forward on to the abdomen, and a median incision made down its posterior

surface to just in front of the anus; in other words, to the central point of the perineum. The skin should next be carefully turned to either side, exposing the superficial fascia. In striking contrast to the superficial fascia in the posterior part of the perineum, which is loaded with fat, the superficial fascia in the anterior part is almost free from fat. As it passes over the scrotum it has a ruddy colour, due to

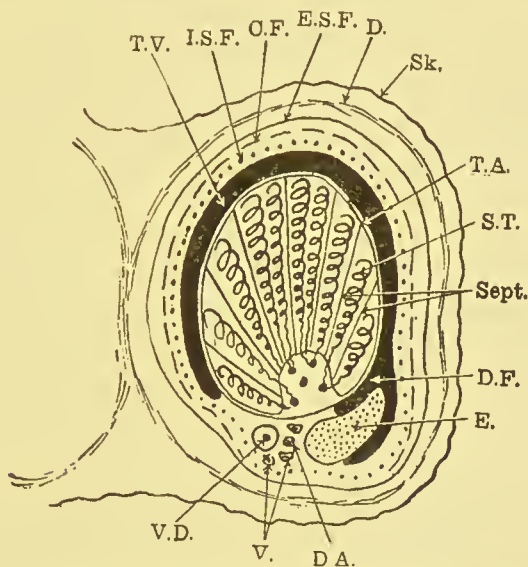


FIG. 231.—HORIZONTAL SECTION THROUGH THE SCROTUM AND RIGHT TESTIS. (DIAGRAMMATIC.)

Sk. Skin. *D.* Dartos. *E.S.F.* External Spermatic Fascia. *C.F.* Cremasteric Fascia. *I.S.F.* Internal Spermatic Fascia. *T.V.* Tunica Vaginalis. *T.A.* Tunica Albuginea. *Sept.* Septa. *S.T.* Seminal Tubules. *D.F.* Digital Fossa. *E.* Epididymis. *D.A.* Deferential Artery. *V.* Pampiniform Plexus. *V.D.* Vas Deferens.

the presence of a number of involuntary muscular fibres, the *dartos muscle*, from which the fascia in that region derives its name of *dartos fascia*.

Incise the dartos tissue carefully, when some very loose connective tissue will be seen, resembling the superficial fascia of the eyelids, and, like that tissue, an early site of œdema in certain diseases. It is not continuous from one

side of the scrotum to the other, because the deeper layer of the dartos forms a median septum. With a very little dissection the testis, enclosed in its *parietal tunica vaginalis* or bag-like covering, may be lifted out, and the spermatic cord exposed as far as the external abdominal ring.

Examine the laid-open coverings of the cord carefully, because they are the coverings of an inguinal hernia—the commonest form of rupture.

Deep to the skin and superficial fascia look for the external spermatic fascia, then the cremaster muscle thinning out into the cremasteric fascia, and deep to that the internal spermatic or infundibuliform fascia. All these have been dealt with already in the dissection of the inguinal canal.

Slit open the tunica vaginalis from in front, when the testis and epididymis will be seen.

Notice that the *tunica vaginalis* is a closed sac into which the testis and part of the epididymis are invaginated from behind, so that all the testis, except a strip down its posterior part where the vessels enter it, or where the epididymis touches it, is covered by the glossy visceral layer of the tunica vaginalis.

On the outer side the tunica vaginalis forms a pouch between the testis and the epididymis, known as the *digital fossa*, very useful in recognising the side of a removed testis (Fig. 231, D.F.).

Dissect out the other testis in its unopened tunica vaginalis, cutting the cord at the level of the external abdominal ring.

Take a large sharp knife and make a clean transverse section through the testis and epididymis, as well as through the bag enclosing them. This will give a very good idea of the relations of the various structures, as well as the mode of reflexion of the tunica vaginalis, particularly if the specimen is placed in a vessel of water.

THE TESTIS

Examine the transverse section of the testis carefully. If it is fresh enough it will show a firm white capsule, the *tunica albuginea*, just within the visceral layer of the tunica vaginalis, while at its posterior part this capsule is thickened and pushed into the substance of the testis to form the *mediastinum testis* (see Fig. 231).

From this some very delicate white lines radiate towards the periphery of the organ, which are the *vertical septa*, and together with the *horizontal septa*, not seen in this section, divide the organ into lobules or *loculi* containing the *semiferous tubules*.

In a very fresh specimen some of these extremely delicate, hair-like tubules may be teased out under water. They are some two feet in length, and the total length of all the tubules of the two testes would probably exceed a mile.

THE EPIDIDYMIS

The part of the *epididymis* seen in this section is known as the *body*, and hardly touches the testis, being separated by the digital fossa.

In the other specimen the whole length of the epididymis is seen lying along the back of the testis as a soft glandular mass; above it enlarges to form the head or *globus major* [caput epididymis], which fits on to the top of the testis like a cap, while below is another smaller enlargement called the tail or *globus minor* [cauda epididymis].

It will be noticed that the head is largely covered by the tunica vaginalis, and so is the outer side and front of the body, but on the inner side the spermatic cord lies close to the body, without any serous membrane intervening.

Draw the *globus major* very gently away from the testis under water. Under very favourable conditions some fifteen

delicate tubules may be seen passing from the testis to the globus major; these are the *vasa efferentia* [ductu' efferentes testis], and as they approach the epididymis they become coiled into little cones known as the *coni vasculosi*.

At the point where the globus major overhangs the front of the testis, look for the sessile and pedunculated *hydatids of Morgagni*, small pyriform vesicles which, however, are not always present.

Now tease out the epididymis under water, and try to make out that its structure is a long, delicate, convoluted tube some twenty feet in length.

THE SPERMATIC CORD

Examine carefully, if possible with a magnifying glass the section of the cord made when one of the testes was removed, or, if necessary, cut a new section a little further down. First look for the *vas deferens* [ductus deferens] or duct of the testis, which is easily recognised at the back of the cord by its whipcord-like feeling; this is so evident that the vas may be readily isolated from the other constituents of the cord through the scrotum in the living body, and is due to the very thick muscular walls and fine lumen of the duct (see Fig. 232).

In front of the vas several thin-walled veins forming the *pampiniform plexus* are seen; they are of considerable clinical importance, because, owing to the loose tissue in which they lie, they often become varicose and then cause the condition known as "varicocele." Among them the *spermatic artery* is usually found injected, while close to the vas another smaller artery, the *deferential* or *artery of the vas*, may be found. A third artery, the *cremasteric*, is a constituent of the cord in the inguinal canal, but has probably reached the cremaster muscle by this time.

Three nerves are bound up with the cord in the inguinal canal; the most important of these is the *spermatic plexus* of

the sympathetic on the walls of the spermatic artery, though this requires delicate dissection to demonstrate; the other two are the *genito-crural*, supplying the cremaster muscle, and the *ilio-inguinal*, the sensory nerve to the scrotum and coverings of the cord. Both of these have been seen in the former dissections.

Among the veins are the *testicular lymphatics*, which require a special and somewhat complicated injection (Gerota's method) to show them up. Dissect all the structures which can be identified downward to the testicle, and look very

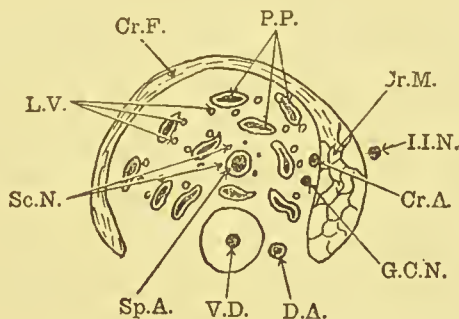


FIG 232.—SECTION OF THE RIGHT SPERMATIC CORD.

V.D. Vas Deferens. D.A. Deferential Artery. Sp.A. Spermatic Artery. Sc.N. Sympathetic Nerves. P.P. Pampiniform Plexus of Veins. L.V. Lymphatic Vessels. Cr.M. Cremaster Muscle. Cr.F. Cremasteric Fascia. Cr.A. Cremasteric Artery. G.C.N. Genito-crural Nerve.

carefully on the front of the cord near the head of the epididymis for a little milky patch known as the *organ of Giralès* or *paradidymis*. Whether this be seen or not, it should be looked for and remembered, because it is a little tubular remnant which may give rise to cystic tumours.

The *spermatic artery*, if well injected, will be seen to give twigs to the epididymis and then enter the back or hilum of the testis.

The *deferential artery* supplies the vas and greater part of the epididymis, where it anastomoses with the spermatic, so that, even if the latter is ligatured or cut, the testis may

still obtain sufficient blood. In rare cases the tunica vaginalis may retain its foetal communication with the peritoneum, a communication known as the *processus vaginalis*, or, more commonly, this may be seen as a delicate fibrous cord.

THE PERINEUM

In former days it was the custom to tie the body up in what is known as the "lithotomy position" and to dissect the perineum before anything else; but, owing to the hardening of muscles caused by the modern use of formalin, the forcible flexion of the thighs so damages the hamstring muscles that the practice has been largely discontinued; moreover, since lateral lithotomy is an operation seldom practised now, it is not of great importance that students should dissect the perineum in this position.

It is quite possible to dissect the perineum with the buttocks raised on blocks and the thighs widely abducted, but it is more satisfactory to wait until the lower extremities have been removed at the hip-joint. As soon as this has been done, the dissection should be undertaken lest the parts become too dry.

It is best to begin with the posterior part of the perineum and to follow the vessels and nerves forward.

First localise the tuber ischii on each side and the tip of the coecyx behind; if the coecyx has not united to the sacrum, it will be found to be to a slight degree movable. The anus should next be examined lying deep in the natal cleft. By pressing the margins of the orifice aside a white line which surrounds the lower end of the gut—the *white line of Hilton*—will be seen. Small bulbous swellings, due to the dilatation of the submucous veins, are very frequently found just within the anal orifice; these are known as hæmorrhoids or piles. Pressure should now be made (*a*) between the anus and the coecyx, and (*b*) between the lateral margin

of the coccyx and tuber ischii. In both places an elastic resistance will be met, due to the ano-coccygeal body and the great sacro-sciatic ligament respectively.

Place a plug of tow in the rectum and sew up the orifice of the anus, after which a transverse incision should be made through the skin an inch in front of the anus, and continued as far as the subpubic ramus in front of the tuber ischii. If necessary, another transverse incision should be made at the level of the tip of the coccyx, though probably the skin will have been reflected here already in the dissection of the gluteal region. Now carry an antero-posterior incision from the middle of the first one to the tip of the coccyx, taking it round each side of the anus. Reflect or remove the flaps and expose the bases of the ischio-rectal fossæ.

The ISCHIO-RECTAL FOSSÆ are pyramidal spaces, one lying on either side of the anus, filled with loose cellular tissue containing much fat. Before any attempt is made to dissect them, an articulated bony pelvis should be at hand placed in exactly the same position as the pelvis which is being dissected.

Notice where the spine of the ischium is in the dry pelvis and realise that this is the apex of the pyramidal space. Now clear away the fat along the outer wall of the ischio-rectal fossa, looking out very carefully for the *inferior hæmorrhoidal vessels and nerve*, which run across the fossa from the ischial spine to the lower part of the rectum close to the anus. Feel very carefully for the ischial spine, remembering that, as the lesser sacro-sciatic ligament is attached to its tip, it will not be felt as a sharp projection. The outer wall of the ischio-rectal fossa is formed by the *obturator internus* fascia and below by the *falciform process of the great sacro-sciatic ligament* [processus falciformis ligamenti sacro-tuberosi] attached to the inner side of the tuber ischii.

At the spine of the ischium the *internal pudic vessels* [vascula pudenda interna] and the *pudic nerve* [n. pudendus]

enter the fossa, the nerve at once breaking up into four branches. Of these the most superficial is the inferior hæmorrhoidal already mentioned, next comes the *superficial*

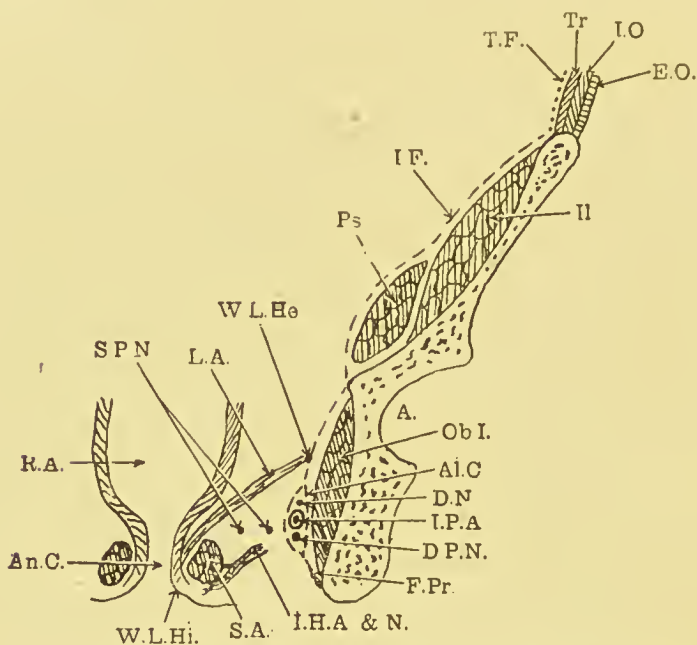


FIG 233.—TRANSVERSE SECTION THROUGH THE PELVIS PASSING DOWNWARDS AND BACKWARDS TO SHOW THE RELATIONS OF THE ISCHIO-RECTAL FOSSA.

E.O. External Oblique. *I.O.* Internal Oblique. *Tr.* Transversalis. *T.F.* Transversalis Fascia. *Il.* Iliacus. *Ps.* Psoas. *I.F.* Iliac Fascia. *A.* Acetabulum. *W.L.He.* White Line of Henle. *W.L.Hi.* White Line of Hilton. *L.A.* Levator Ani. *R.A.* Rectal Ampulla. *An.C.* Anal Canal. *S.A.* Sphincter Ani. *I.H.A. & N.* Inferior Hæmorrhoidal Artery and Nerve. *Ob.I.* Obturator Internus. *Al.C.* Alcock's Canal. *D.N.* Dorsal Nerve of Penis. *I.P.A.* Internal Pudic Artery. *D.P.N.* Deep Perineal Nerve. *F.Pr.* Falciform Process of Great Sacro-sciatic Ligament. *S.P.N.* Superficial Perineal Nerve.

perineal nerve, which soon divides into external and internal branches [nn. serotales posteriores], running forwards through the fat towards the back of the scrotum or labium majus. As soon as these have been found, look for another nerve—the *inferior pudendal* [ramus perinealis nervi eutanei femoris

posterioris]—on the outer side of them. This has been seen in the dissection of the gluteal region, and is a branch of the small sciatic; it winds round the back of the origins of the hamstring muscles an inch below the tuber ischii, but, since the thigh is now amputated, it is probably cut and only its anterior end will be found. It will now be realised that there are three nerves running forward on each side towards the scrotum, the two superficial perineal and the inferior pudendal, which are often known collectively as the three *long scrotal nerves*.

The next branch of the pudic nerve on a deeper plane is the *deep perineal* [n. perinei], accompanying the internal pudic artery forwards in a canal formed by the splitting of the obturator internus fascia known as Alcock's canal. This nerve lies just below (superficial to) the artery (see Fig. 233, D.P.N.).

The fourth and deepest branch of the pudic nerve is the *dorsal nerve of the penis or clitoris*; this will be found in Alcock's canal above (deep to) the pudic artery.

By the time these structures have been found, the space will be largely cleared of fat, and a little more cleaning will show that the inner wall of the pyramidal fossa is formed by the levator ani muscle, sloping downwards and inwards, and the *external sphincter ani*, surrounding the anal canal and attached posteriorly to the tip of the coccyx, and anteriorly to the central point of the perineum where the anterior skin incision was made. It derives its nerve supply from two sources, one nerve entering behind—a twig from the perineal branch of the fourth sacral nerve; the other from the side, a branch from the inferior hæmorrhoidal nerve. These nerves should be found and preserved.

The posterior wall of the ischio-rectal fossa is formed by the gluteus maximus muscle and great sacro-sciatic ligament; it will be remembered that the origin of the muscle was detached from the ligament in the dissection of the buttock.

The pyramidal fossa is now clean, and on revising its boundaries it will be seen that the base is at the surface of the perineum, the apex at the ischial spine, the outer wall formed by the obturator internus fascia and the falciform process of the great sacro-sciatic ligament, the inner wall by the levator ani and external sphincter ani, and the posterior wall by the gluteus maximus and great sacro-sciatic ligament. Further notice that all the contents of the space enter at the apex by winding round the spine of the ischium. The large amount of fat in the fossa allows the lower portion of the alimentary canal to undergo considerable dilatation in the act of defæcation. The fat occasionally becomes infected from the anal canal or other adjoining parts or from the blood, and an ischio-rectal abscess forms. Should this abscess burst, the condition known as fistula in ano may result.

The ANTERIOR PART OF THE PERINEUM OR URETHRAL TRIANGLE is the part bounded in front by the symphysis pubis, laterally by the subpubic rami, and behind by an imaginary transverse line running through the central point of the perineum an inch in front of the anus.

As this differs in the two sexes the arrangement in the male will be described first.

Make a medial skin incision along the perineal ridge or raphe from the back of the scrotum, which has been hooked forwards, to the central point of the perineum. A transverse skin incision at the back of the scrotum will allow the two flaps to be turned outwards.

At the back of the scrotum notice that the dartos tissue (see Fig. 234, D.) loses its muscular fibres and divides into two layers, the more superficial of which (Fig. 234, S.F.) is the ordinary, fat-containing, superficial fascia in which the long scrotal nerves may be traced forwards.

The deeper layer contains little fat and is known as Colles' fascia (Fig. 234, C.F.). Put the nozzle of a syringe into the back of the scrotum deep to the dartos; let it point backwards and inflate the space deep to Colles' fascia. The

urethral triangle of the perineum will be blown up, but the air will not pass backward into the ischio-rectal fossa nor laterally into the thighs unless accidental punctures have been made.

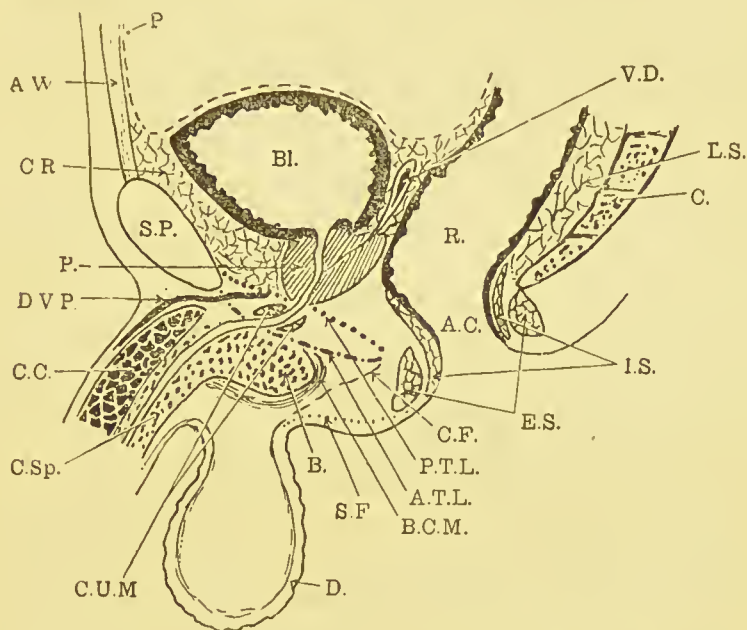


FIG. 231.—SAGITTAL SECTION THROUGH THE MALE PELVIS.
(DIAGRAMMATIC.)

A.W. Abdominal Wall. *P.* Peritoneum. *P.* Prostate. *C.R.* Cavum Retzii. *S.P.* Symphysis Pubis. *Bl.* Bladder. *V.D.* Ampulla of Vas Deferens. *R.* Rectum. *A.C.* Anal Canal. *L.S.* Retro-rectal Lymph Space. *C.* Coccyx. *D.V.P.* Dorsal Vein of Penis. *C.C.* Corpus Cavernosum. *C.Sp.* Corpus Spongiosum. *C.U.M.* Compressor Urethrae Muscle. *B.* Bulb. *E.S.* External Sphincter. *I.S.* Internal Sphincter. *B.C.M.* Bulbo-cavernosus Muscle. *D.* Dartos. *S.F.* Superficial Fascia. *C.F.* Colles' Fascia. *A.T.L.* Anterior Layer of Triangular Ligament. *P.T.L.* Posterior Layer of Triangular Ligament.

This shows that the fascia is attached to deeper structures laterally and posteriorly, a fact which is of clinical importance in limiting the flow of extravasated urine.

Clean away Colles' fascia carefully and expose the root of the penis surrounded by its muscles.

In the mid line the bulb of the corpus spongiosum (Fig. 234, B.) will be seen covered by a thin sheath of muscle, the *bulbo-cavernosus* (B.C.M.). Notice that this is a bilateral muscle rising behind from the central point or tendon of the perineum and further forward from a median raphe on the surface of the bulb.

The fibres surround the bulb and are for the most part

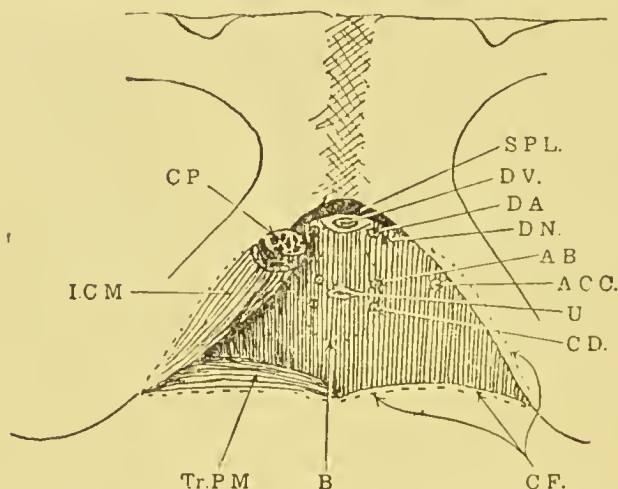


FIG. 235.—DISSECTION TO EXPOSE THE ANTERIOR LAYER OF THE TRIANGULAR LIGAMENT ON ITS SUPERFICIAL ASPECT.

S.P.L. Subpubic Ligament. *D.V.* Dorsal Vein of Penis. *D.A.* Dorsal Artery of Penis. *D.N.* Dorsal Nerve of Penis. *C.P.* Crus Penis. *I.C.M.* Ischio-cavernosus Muscle. *Tr.P.M.* Transversus Perinei Muscle. *B.* Site occupied by Bulb (dotted). *U.* Urethra. *A.B.* Artery of Bulb. *C.D.* Duct of Cowper's Glands. *A.C.C.* Artery of Corpus Cavernosum. *C.F.* Line of Attachment of Colles' Fascia (dotted).

inserted into its upper surface, but some of the more anterior surround the corpora cavernosa and meet above the dorsal vein of the penis.

On each side of the bulb is the crus penis (Fig. 235, C.P.) covered by the *ischio-cavernosus muscle* (I.C.M.), which rises from the inner side of the tuber ischii and is inserted into the outer side of the crus.

The third muscle in this compartment is the *transversus perinei* (Fig. 235, Tr.P.M.), which, however, is not always

present, or may be present on one side only. It rises from the junction of the tuber ischii with the subpubic ramus, and is inserted into the central point of the perineum.

If the deep perineal nerve is followed forward from the ischio-rectal fossa, it will be found to enter and supply these three muscles.

Now clear away the bulbo-cavernosus muscle and examine the *bulb* (Fig. 234, B.), which is the posterior end of the corpus spongiosum, and is a mass of erectile tissue surrounding the urethra, which is here slightly enlarged. It will be well to lay open the part of the urethra contained in the bulb.

In the same way dissect the ischio-cavernosus muscle away from the *crus penis* in order to examine this latter structure. Each crus is attached to the inner surface of the ischial ramus close to its lower border. Cut into one of them, and notice how the erectile tissue of the corpus cavernosum gradually gives way to the fibrous tissue of the crus near its attachment.

Now separate the crura penis from the bone, and remove the bulb, very carefully cutting through the urethra just behind it. Cut the dorsal vessels of the penis as long as possible, so as to be able to identify them easily hereafter.

Occupying the triangular space between the pubic rami, and forming the floor of the superficial perineal compartment, is a dense but very indefinite mass of connective tissue known from its position and shape as the *superficial layer of the triangular ligament*. Behind it fuses with Colles' fascia, laterally with the subpubic rami, while anteriorly it ends in a strong band situated immediately underneath the dorsal vein of the penis—the *transverse perineal ligament*. It will be found to give a fascial expansion which covers the bulb. It is pierced in the mid line, an inch below the symphysis, by the urethra, and close to this, on either side, the artery to the bulb (Fig. 234, A.B.) and the duct of Cowper's gland should be sought. Just below the sym-

physis, on either side of the dorsal vein, the dorsal artery and dorsal nerve of the penis pierce the ligament (Fig. 234, D.A. and D.N.), while laterally, quite close to the sub-pubic arch, the artery to the corpus cavernosum comes through very obliquely.

The superficial layer of the triangular ligament should now be turned back after the following incisions have been made, one in the middle line, one just behind the transverse perineal ligament, and one along the pubic ramus. The compartment now exposed is termed the *deep perineal compartment*. It is occupied by the membranous portion of the urethra, three-quarters of an inch long and very narrow, surrounded by the compressor urethræ muscle, and in close relation to Cowper's glands (see Fig. 234, C.U.M.).

The *compressor urethræ* arises from the pubic ramus at its junction with the ischial, and is inserted with its fellow of the opposite side into a median raphe on the upper and lower surfaces of the membranous urethra.

Cowper's glands, as a rule, are not easily found in dissecting-room subjects, since they atrophy after puberty. They are small pea-like glands situated behind the membranous urethra, covered by a few fibres of the compressor, and crossed superficially by the artery to the bulb. Their ducts enter the wall of the membranous urethra, running in the wall for some distance to open into the spongy urethra.

The latter should now be slit along on its upper surface, the orifices of Cowper's duct discovered, if possible, and a bristle passed through them. The floor of the deep perineal compartment is formed by the *deep layer of the triangular ligament*, which passes as a sheet between the pubic rami, and is continuous laterally with the fascia over the obturator internus. It is a slight condensation of the pelvic cellular tissue in adaptation to the support of the prostate; incidentally it fixes in position the urethra. A dry pelvis should be examined, and if the hand is passed within it from below and swept from tuber ischii to tuber ischii across the pubic arch,

it will convey some idea of the way in which the fascia over the obturator internus is continuous with the deep layer of the triangular ligament. It will be also understood that the internal pudic vessels and pudic nerve, which lie external to the fascia over the obturator internus, pierce that fascia by means of Alcock's canal, and enter the lateral portion of the deep perineal compartment. The terminal branches of the artery and the nerve then pierce the superficial layer of the triangular ligament to enter the superficial perineal compartment.

In the dissection of the female perineum the external generative organs must be examined, though the student is warned that by the female perineum the gynæcologist understands only that area which intervenes between the external organs of generation and the anus.

The VULVA or PUDENDUM includes all the female external generative organs, and consists of the labia majora, labia minora, clitoris, vestibule, orifices of the vagina and urethra, bulbs of the vestibule and Bartholin's glands. The *labia majora* are the large folds of skin covered on their outer surfaces with hair, and usually having their smooth, moist, internal surfaces in contact so as to conceal the other external generative organs. Make a section of one of them, and notice that it contains fibro-fatty tissue continuous with the mass of similar tissue in front of the symphysis pubis forming the *mons veneris*. The labia majora are the homologues of the two halves of the scrotum in the male.

The *labia minora* or *nymphæ* are smaller flaps or folds of skin covered by the contiguous labia majora; below they join to form the *fourchette*, but above they approach one another and bifurcate.

The upper limb of the bifurcation seems to join its fellow to form a little hood over the glans clitoridis known as the *preputium clitoridis*, while the lower limb blends with the clitoris. Some observers, however, hold that the preputium is quite distinct from the nymphæ.

The *clitoris* is so deeply sunk in the surrounding tissues that only its tip or glans can be made out at present.

The *vestibule* is the space within the labia minora between them and the vaginal orifice.

The *orifice of the vagina* (Fig. 236, V.) varies greatly in the virgin and in women who have borne children; in the former it is partly closed by a delicate, membranous, crescentic fold known as the *hymen* (Fig. 236, H.). This usually

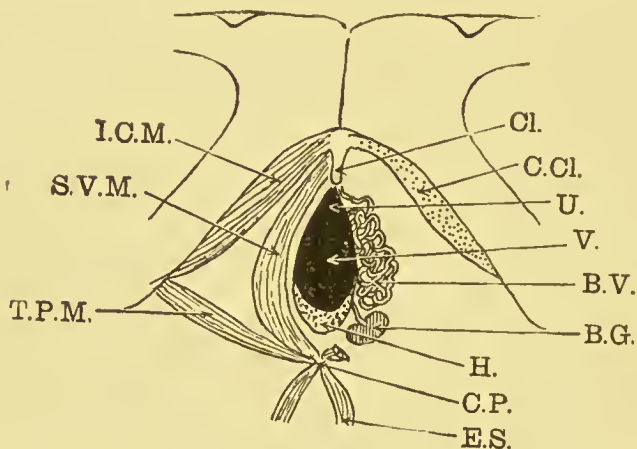


FIG. 236.—DISSECTION OF THE EXTERNAL GENERATIVE ORGANS OF THE FEMALE. (DIAGRAMMATIC.) ON THE LEFT SIDE THE MUSCLES HAVE BEEN DISSECTED AWAY.

I.C.M. Ischio-cavernosus Muscle. *S.V.M.* Sphincter Vaginæ Muscle. *T.P.M.* Transversus Perinei Muscle. *E.S.* External Sphincter Muscle. *Cl.* Clitoris. *C.Cl.* Crus Clitoridis. *U.* Urethral Orifice. *V.* Vaginal Orifice. *H.* Hymen. *B.V.* Bulb of the Vestibule. *B.G.* Bartholin's Glands. *C.P.* Central Point of Perineum.

disappears after coitus, and always after childbirth, but its position is marked by a series of little knob-like elevations—the *carunculae myrtiformes*.

The orifice of the vagina should be held open with hooks and the interior of the passage examined; if a vaginal speculum is obtainable, it should be inserted.

In the nullipara (a female who has not borne children) the mucous membrane is thrown into transverse ridges or

ruga, which disappear to a considerable extent after childbirth.

At the upper part of the anterior wall of the vagina look for the *os uteri*, a transverse slit usually from a quarter to half an inch in length; it will be examined more carefully with the uterus later.

The *urethral orifice* (Fig. 236, U.) should be noticed with great care; it lies just above the vaginal orifice and an inch below the tip of the clitoris. The opening usually pouts a little, so that it may be felt by the finger, and on either side of it there is a small *para-urethral pocket* which may snare the point of the catheter.

It is well to practise passing a catheter by touch alone, and, in order to do this, put the index finger within the vaginal orifice with its palmar side towards the symphysis, then slide the catheter along this, keeping it exactly in the middle line, when, with a little manipulation, the point should slip into the urethra.

One of the most characteristic things about the female urethra is its extreme distensibility; this, of course, is masked by formalin, but in a fresh subject the handle of a scalpel can be easily passed into the bladder.

The *bulbs of the vestibule* (see Fig. 236, B.V.) are masses of erectile tissue resting one on either side against the orifice of the vagina, and covered by a thin layer of muscle—the *sphincter vaginae* (Fig. 236, S.V.M.) corresponding to the bulbo-cavernosus of the male. Each bulb of the vestibule is the equivalent of half the bulb in the male, and above the vaginal orifice they coalesce and are continued into the clitoris by a narrow strip of erectile tissue known as the *pars intermedia*.

Bartholin's glands [Gl. vestibularis majores] (Fig. 236, B.G.) should be looked for, one on either side, overlapped by the lower or posterior end of the bulb of the vestibule; each is like a very small kidney bean, and has a delicate duct which opens into the vestibule at the side of the orifice of

the vagina and just internal to the labium minus. The gland represents Cowper's gland in the male.

Now dissect away the labia, and expose the *clitoris*. This is the homologue of the glans and corpora cavernosa penis. Its body (Fig. 236, Cl.) is about an inch long, having a small pointed glans at the tip, which is not perforated by the urethra. Dissect out the *crura clitoridis* (Fig. 236, C.Cl.) corresponding to the crura penis, but of smaller size, and covered by a small ischio-cavernosus muscle (Fig. 236, I.C.M.).

The *transversus perinei muscle* (Fig. 236, T.P.M.) in the female corresponds, when present, with that of the male in its attachments. If the labia minora are regarded as the split floor of the male penile urethra, it will be seen from the foregoing that all the parts of the male genital apparatus are present in the female, though they usually retain the foetal arrangement and fail to fuse in the mid line below.

The *superficial layer of the triangular ligament* is present in the female deep to the crura clitoridis; it is, however, difficult to recognise, being deeply notched by the orifice of the vagina.

ABDOMINAL CAVITY

The anterior wall of the abdomen having been dissected, the student should now proceed to the study of the abdominal cavity and its contents.

Make a vertical incision close to but not quite in the mid line from the level of the umbilicus to the symphysis pubis. Through the upper limit of this incision carry another incision transversely across the abdomen from one side to the other. Now turn the two resulting triangular flaps downwards, and note that, occupying the median line, *i.e.* on the median edge of the larger flap, there is a somewhat indistinct fibrous cord which, beginning at the umbilicus, can be traced down to the pelvis, where it will later be seen to be continuous with the apex of the bladder—it is known

as the *urachus*. The deep surface of both flaps is lined by a glistening serous membrane—the parietal peritoneum. A similar membrane—the visceral peritoneum—covers the viscera exposed. A little manipulation will show that laterally these two membranes are continuous with each other.

Now, holding the palm of the hand upwards, pass the index and middle fingers of the left hand—one on either side of the mid line—upwards behind the upper part of the anterior abdominal wall. A little movement from side to side will demonstrate the existence of a thin vertical sheet of peritoneum passing upwards, backwards, and to the right from the median line. This is the *falciform ligament of the liver*.

With a pair of strong scissors cut upwards on either side of this ligament as far as is possible, taking care not to injure underlying structures with the point of the scissors. The two resulting triangular flaps may next be turned up, and are seen to be lined with the parietal peritoneum. The four flaps should be hooked back, thereby exposing the whole of the peritoneal cavity and its contents.

THE PERITONEUM

Before proceeding to the study of the peritoneum in detail, there are certain general facts in regard to it which must be realised.

First imagine it as a thin membrane lining a simple cavity; then as a membrane which, in addition to lining such a cavity, is reflected without loss of continuity over various structures which are developed immediately without the membrane and project more or less completely into the cavity. In consequence of this we can distinguish a parietal layer of peritoneum lining the cavity and a visceral layer reflected over the viscera. In certain cases the viscus is entirely covered by peritoneum, except along a narrow linear

area posteriorly, *e.g.* the small intestine; in other cases a broad and irregular area is left uncovered posteriorly, *e.g.* the liver.

The relatively simple arrangement of the peritoneum so far implied is complicated by the following tendencies:—

(*a*) The change in position of the viscus and the consequent drag on its peritoneal covering; (*b*) the union of two opposed layers of peritoneum; (*c*) the absorption of the peritoneum from that surface of a viscus which has become pressed against the wall of the cavity; (*d*) the overgrowth of the peritoneum; (*e*) the adaptive strengthening in certain regions to form suspensory ligaments; (*f*) the presence of underlying vessels producing vascular folds; (*g*) the formation of pouches. Illustrations of these tendencies will be noted as they occur in the description.

The student should fix by means of pins a series of strings along the transpyloric, subcostal, intertubercular and *mid-Poupart lines* (noticed on p. 79), in this way dividing the abdomen into compartments, each containing viscera the position of which is usually stated in terms of these compartments. The liver will be found to lie chiefly in the right hypochondriac and epigastric compartments, but to pass slightly into the left hypochondrium and right lumbar region. The stomach lies almost equally in the epigastric and left hypochondriac regions. The gall-bladder lies at the extreme right of the epigastric zone. The cæcum lies in the right iliac compartment; the ascending colon may be partly seen ascending through the right lumbar region into the right hypochondriac, the descending colon descending through the same regions on the left side. The left iliac fossa is partially occupied by the iliac colon. In the hypogastric zone will be seen the pelvic viscera. Coils of small intestine occupy the space enclosed by the horse-shoe-shaped loop of large intestine, but are largely concealed by the fold of peritoneum which descends from the great curvature of the stomach and is known as the great omentum.

The Great Omentum.—This fold of peritoneum should be

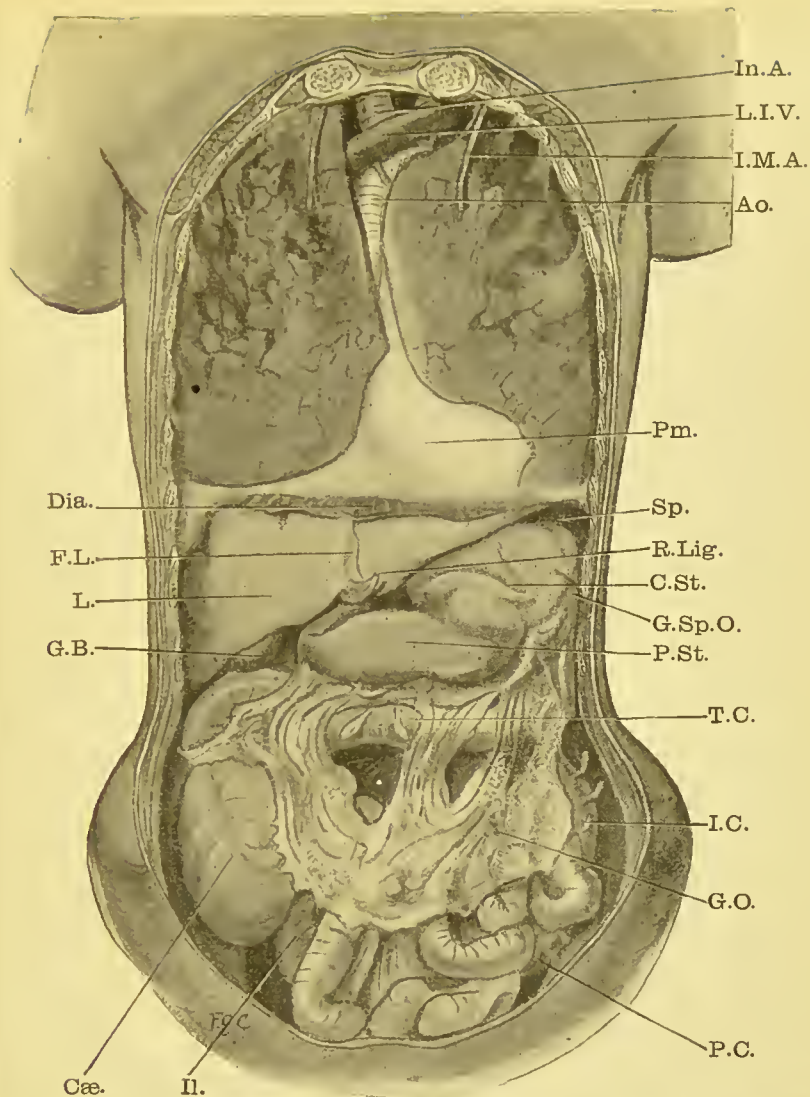


FIG. 237.—HARDENED VISCERA UNDISTURBED AFTER REMOVAL OF THE FRONT OF THE BODY WALL.

In.A. Innominate Artery. *L.I.V.* Left Innominate Vein. *I.M.A.* Internal Mammary Artery. *Ao.* Aorta. *Pm.* Pericardium. *Dia.* Diaphragm. *F.L.* Falciform Ligament. *L.* Liver. *G.B.* Gall Bladder. *Sp.* Spleen. *R.Lig.* Round Ligament. *C.St.* Cardiac Portion of Stomach. *G.Sp.O.* Gastro-splenic Omentum. *P.St.* Pyloric Portion of Stomach. *T.C.* Transverse Colon. *I.C.* Iliac Colon. *G.O.* Great Omentum (two cuts have been made in it to show the Transverse Colon). *P.C.* Pelvic Colon. *Cæ.* Cæcum. *Il.* Ileum.

straightened out and carefully followed from right to left. At its right border it will be found to gradually shorten and disappear; its left border passes upwards over the colon and below the spleen to be attached to the diaphragm; the portion which passes between the colon and diaphragm is known as the *phrenico-colic ligament*. If the great omentum be now traced upwards, it will be found to be attached to the great curvature of the stomach and to pass up between the fundus and spleen as the *gastro-splenic omentum* [lig. gastro-lienale]. Between the great curvature of the stomach and the free border of the great omentum, the transverse colon will be seen in most cases passing from right to left in the substance of the omentum. On examining the structure of the great omentum carefully, it will be noticed that it is not a uniform sheet, but is perforated like a piece of delicate lace or like the tracery of a decayed leaf.

Note carefully how low the great omentum reaches—this varies a good deal in different bodies; it is sometimes long enough to cover the external genitals when drawn down, while at other times it is greatly contracted, and not infrequently adherent to certain of the viscera over which it lies. If with the forceps the superficial layer of the omentum be pinched up, the deep layer will be found to fall away, disclosing a cavity between the two layers. This is the cavity of the *lesser sac* [bursa omentalis]. The great omentum should now be turned up over the thorax. The transverse colon will be carried up with it, and an excellent view of this viscus will be obtained. The fold of peritoneum, which reaches from the transverse colon to the posterior abdominal wall, which it reaches just below the pancreas, is called the *transverse meso-colon*. Make a small vertical incision through the transverse meso-colon, which will then be seen to consist of two layers of peritoneum, enclosing between them blood vessels and a variable amount of fat. Pass a finger through the incision into the lesser sac, and feel the posterior surface of the stomach.

Replace the transverse colon and great omentum in their original position, and, having pinched up the superficial layer of the omentum a little below the stomach, make a horizontal incision through it. If now the margins of the incision are lifted up and held apart, an excellent view of the lesser sac can usually be obtained through the aperture, and the cavity should be explored with the finger. Note that it passes upwards behind the stomach, the first part of the duodenum, and the liver, to the diaphragm; it passes downwards in front of the transverse colon; to the left it is closed by the gastro-splenic omentum, the spleen, and a fold passing from the spleen to the left kidney, *the lieno-renal ligament*; to the right it is closed below the duodenum by the meeting of the two layers of the omentum, but above the duodenum it communicates with the great sac through a vertical slit, which may be opened to the size of half-a-crown, the foramen of Winslow [f. epiploicum]. These relations having been made out, the following viscera should be palpated: the liver, stomach, duodenum, spleen, kidney, and pancreas; the last viscus stretches across the posterior abdominal wall just above the attachment of the transverse meso-colon. Draw the stomach forward, and note the *right* and *left pancreatico-gastric folds* running back from the pyloric and cardiac portions of the stomach respectively. Finally the dissector must realise that, below the transverse colon, the great omentum consists of four layers, of which the first and fourth belong to the greater sac, the second and third to the lesser. Above the transverse colon the third and fourth layers become the transverse meso-colon, and then the great omentum is only formed by the first and second layers. This will be clear on referring to Fig. 238.

The finger should now be withdrawn, and the foramen of Winslow found and penetrated from the great sac. To do this mark the gall bladder, pass the left index finger along it from the fundus to neck, when, by crooking the finger to the left, it will enter the foramen. The foramen which, it is well

to know, is situated at the level of the 12th thoracic or 1st lumbar vertebra, is bounded in the following manner;

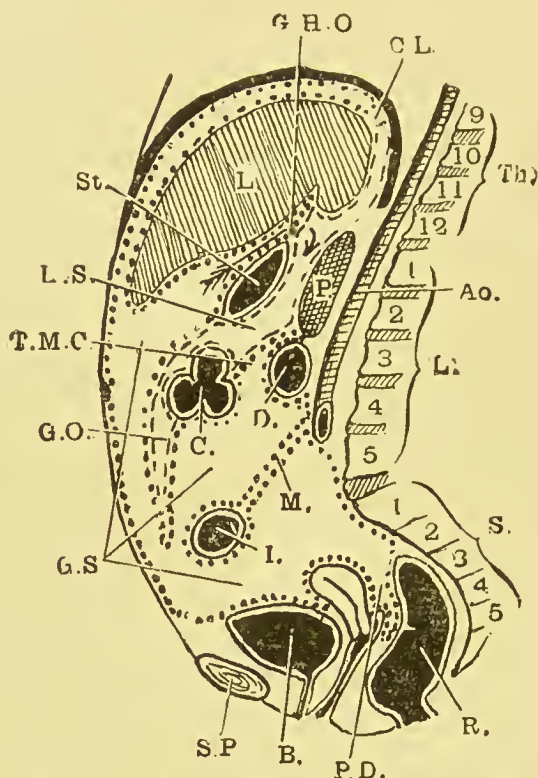


FIG. 238.—DIAGRAMMATIC SAGITTAL SECTION THROUGH THE MID LINE OF THE ABDOMEN.

(The Peritoneum of the Greater Sac is a dotted, that of the Lesser an interrupted line.)

L. Liver. *P.* Pancreas. *C.* Transverse Colon. *D.* Third Part of the Duodenum. *St.* Stomach. *Ao.* Aorta. *I.* Small Intestine. *S.P.* Symphysis Pubis. *B.* Bladder. *R.* Rectum. *C.L.* Coronary Ligament. *G.H.O.* Gastro-hepatic (Lesser) Omentum (the arrow is passing through the Foramen of Winslow). *G.O.* Great Omentum. *T.M.C.* Transverse Mesocolon. *L.S.* Lesser Sac. *G.S.* Greater Sac. *M.* Mesentery. *P.D.* Pouch of Douglas.

anteriorly by the free edge of a fold of peritoneum, called the *gastro-hepatic omentum*, which extends from the small curvature of the stomach to the transverse fissure of the

liver; posteriorly by the parietal peritoneum, covering the inferior vena cava; above by the caudate lobe of the liver; below by the first part of the duodenum and the hepatic artery. If the free edge of the gastro-hepatic omentum be

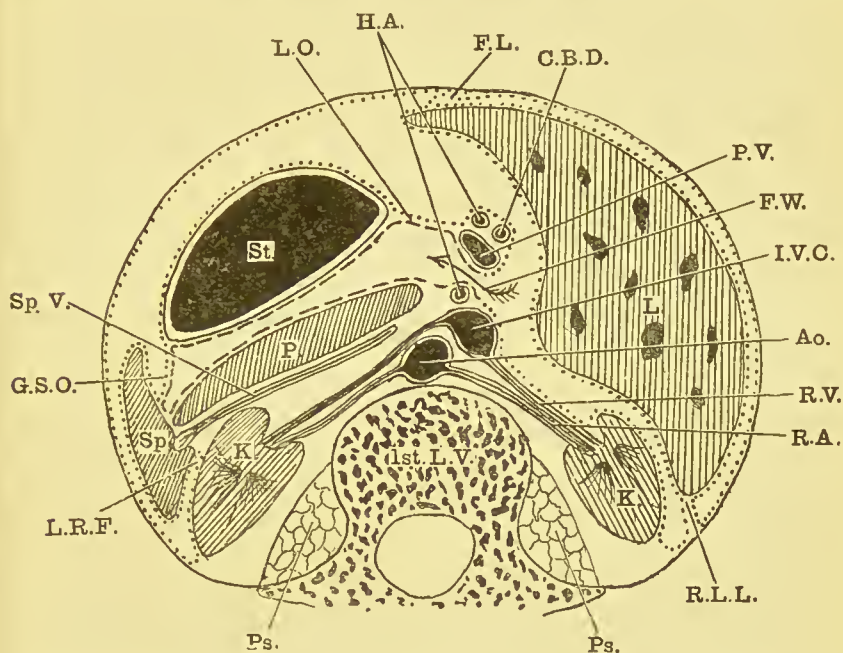


FIG. 239.—DIAGRAMMATIC SECTION THROUGH THE FIRST LUMBAR VERTEBRA TO SHOW THE REFLEXIONS OF THE PERITONEUM.

F.L. Falciform Ligament. *H.A.* Hepatic Artery. *C.B.D.* Common Bile Duct. *P.V.* Portal Vein. *F.W.* Foramen of Winslow. *I.V.C.* Inferior Vena Cava. *L.* Liver. *Ao.* Aorta. *R.V.* Renal Vein. *R.A.* Renal Artery. *R.L.L.* Right Lateral Ligament of Liver. *K.* Kidney. *Ps.* Psoas. *L.R.F.* Lieno-renal Fold (the Pancreas has lifted off the other Layer of the Lieno-renal Ligament). *Sp.* Spleen. *G.S.O.* Gastro-splenic Omentum. *Sp.V.* Splenic Vein. *St.* Stomach. *L.O.* Lesser Omentum.

rolled between the finger and thumb, it may be possible to distinguish three structures, which, from right to left, are the common bile duct, portal vein, and hepatic artery; the portal vein lies posterior to the other two; in fact, during life, so narrow is the slit-like foramen, that the portal vein is an

intimate and direct anterior relation to the inferior vena cava.

The *Gastro-hepatic* or *Small Omentum* [lig. hepato-gastricum] (see Fig. 239, L.O.).—This distinct fold of peritoneum should now be examined. It is attached above to the liver and diaphragm, below to the stomach and first part of the duodenum. At the left it splits on reaching the œsophagus and fundus of the stomach, its superficial layer passing in front of these viscera to become continuous with the gastro-splenic omentum; its deep layer, after covering the right side of the œsophagus, becomes continuous with the parietal layer of the peritoneum on the posterior abdominal wall, so that small portions of the posterior surfaces of the œsophagus and stomach are left uncovered by the peritoneum; it is here, where the two layers of peritoneum forming the gastro-hepatic omentum separate, that the coronary vessels gain an entrance into the fold. To expose them draw the œsophagus and stomach down, and make an incision through the peritoneum immediately above the left portion of the small curvature of the stomach.

The vessels lie in a little loose cellular tissue occupying the space between the two layers of peritoneum. It will be understood that a perforation of the stomach over this bare area is liable to lead to acute hemorrhage and to an extra-peritoneal form of subphrenic abscess.

Ligaments of the Liver.—Passing from the anterior abdominal wall above the umbilicus to the liver is the sickle-shaped fold of peritoneum, already referred to as the *falciform ligament*. In the free lower border of this lies a rounded cord, the *Ligamentum teres* or obliterated umbilical vein. Trace this cord backward, when it will be found to enter the anterior part of the longitudinal fissure of the liver; its further extension will be studied later. The *coronary ligament* consists of two layers of peritoneum separated by a broad, irregular, bare area on the posterior surface of the liver. These layers can be demonstrated best

by passing one hand above the right lobe of the liver and the other below the right lobe; the meeting of the two hands is prevented by the reflexion of the peritoneum from the liver to the diaphragm above, and from the liver to the posterior abdominal wall below. The liver should next be pulled, first to the right and then to the left, when slight folds of peritoneum will be seen passing on either side from it to the diaphragm—the *right and left lateral ligaments*. It will be seen that the space between the liver and diaphragm is divided by the falciform ligament into right and left portions, each of which is again divided by the lateral ligaments into a large anterior and a small posterior part, so that there are four compartments, and therefore four anatomical varieties of intra-peritoneal subphrenic abscesses are possible.

The Mesentery.—Take hold of a loop of small intestine and pull it forward, when it will be seen to be attached to the posterior abdominal wall by a strong fold of peritoneum—the mesentery. Trace the small intestine upwards to the left side of the 2nd lumbar vertebra, where the free portion of the small intestine will be found to join a fixed portion at a bend—the *duodeno-jejunal flexure*; it is at this flexure that the mesentery begins. Now trace the small intestine downwards to the ileo-cæcal junction in the right iliac fossa, where it and its mesentery end. The mesentery will by this procedure be shown to be attached to the posterior abdominal wall along an oblique line from the left side of the 2nd lumbar vertebra to the right iliac fossa (see Fig. 240, M.). By examining a short length of small intestine it will be seen to be covered by peritoneum everywhere except along a narrow linear area. The length of the mesentery at its parietal attachment is 6 or 7 inches; at its intestinal attachment, 23 feet. From posterior abdominal wall to the intestine its maximum length is about 10 inches, but considerable variation is met with. In some cases the mesentery is so short that an inguinal or femoral hernia of this portion of the gut would be impossible.

Between the layers of the mesentery there is an accumulation of fat which in the upper part of the small intestine

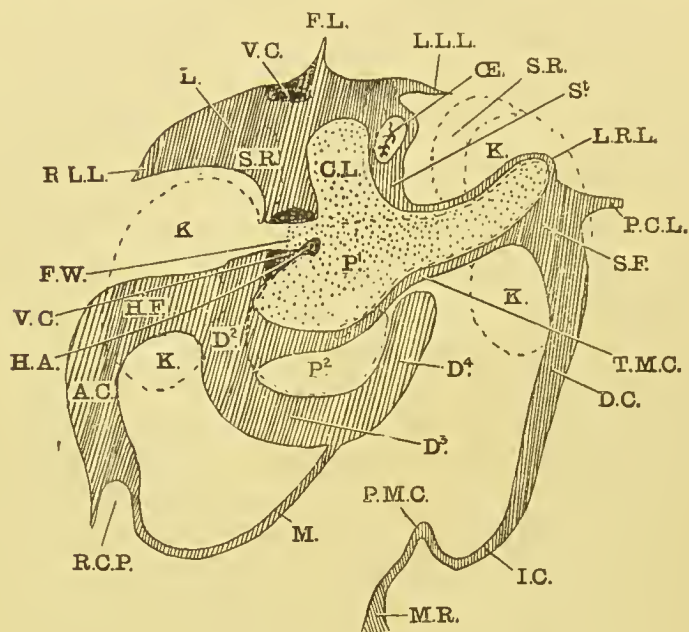


FIG. 240.—DIAGRAM OF THE POSTERIOR ABDOMINAL WALL AFTER THE REMOVAL OF ALL THE VISCERA EXCEPT THE KIDNEYS, SUPRARENALS, AND PANCREAS TO SHOW THE REFLEXION OF THE PERITONEUM.

(The Great Sac is white, the Lesser Sac dotted, and the parts uncovered by Peritoneum shaded.)

F.L. Falciform Ligament. *L.L.L.* Left Lateral Ligament of Liver. *Æ.* Œsophagus. *S.R.* Suprarenal Gland. *S^t*. Bare Area behind Stomach. *L.R.L.* Lieno-renal Ligament. *P.C.L.* Phreno-colic Ligament. *S.F.* Splenic Flexure of Colon (removed). *C.L.* Caudate Lobe of Liver (removed). *P¹*. Greater Part of Pancreas (still *in situ*). *P²*. Lower Part of Head of Pancreas (still *in situ*). *K.* Kidney (still *in situ*). *T.M.C.* Transverse Meso-colon. *D.C.* Descending Colon (removed). *I.C.* Iliac Colon (removed). *P.M.C.* Pelvic Meso-colon. *M.R.* Mesorectum. *D², D³, D⁴*. Second, Third, and Fourth Parts of Duodenum (removed). *M.* Mesentery. *R.C.P.* Retro-colic Pouch. *A.C.* Ascending Colon (removed). *H.A.* Hepatic Artery, Portal Vein, and Bile Duct. *V.C.* Vena Cava (this has been cut in two places and a piece removed with the Liver). *F.W.* Foramen of Winslow (in front of Vena Cava). *R.L.L.* Right Lateral Ligament of Liver. *L.* Bare Area left on removal of Liver.

does not reach as far as the gut, but leaves windows of transparent peritoneum between the mesenteric vessels. In the lower part of the intestine the fat fills up all the interval between the vertebral column and the gut, and there are no "windows" at all in the mesentery (see Figs. 241, 242).

It is often necessary, in the living body, to determine the



FIG. 241.—A LOOP OF SMALL INTESTINE IN ITS UPPER PART SHOWING THE WINDOWS LEFT BETWEEN THE GUT AND THE MESENTERIC FAT.

upper and lower ends of a coil of small intestine withdrawn from an abdominal incision. Here the obliquity of the attachment of the mesentery to the posterior abdominal wall is a great help, because, by sliding a finger along the mesentery until this attachment is reached, it is easy to tell the lower and right from the upper and left attachment of the mesentery.

By a further examination of the duodeno-jejunal flexure

the terminal portion of the duodenum will be seen to be fixed, being only covered by peritoneum anteriorly and to some extent laterally. The duodenum, traced to the right, will be seen to pass upwards, under cover of the transverse mesocolon, to become continuous with the first portion of the jejunum, which is freely movable.



FIG. 242.—A LOOP OF SMALL INTESTINE IN ITS LOWER PART SHOWING THE MESENTERIC FAT REACHING THE GUT AND LEAVING NO WINDOWS.

The large intestine should next be examined. The *appendix* [processus vermiformis] is attached to the cæcum by a falciform fold of peritoneum containing blood vessels—the *meso-appendix*. The apex of the appendix is free and has usually one or two leaflets of subserous fat. The cæcum is covered by peritoneum anteriorly, laterally, and, as a rule,

posteriorly. Occasionally, however, a portion of the posterior surface is left uncovered; how much is so left can be demonstrated by passing the hand upwards behind the cæcum and noting the relationship between the line of peritoneal reflexion and the ilio-cæcal junction.

The ascending colon, descending colon, and iliac colon are covered by peritoneum, as a rule, anteriorly and laterally only. The pelvic colon, like the small intestine, is covered by peritoneum everywhere except along a linear area posteriorly. The attachment of the pelvic meso-colon to the abdominal wall often passes first upwards from the inner border of the psoas to the promontory, and then downwards in the middle line to the 3rd sacral vertebra (see Fig. 240, P.M.C.). It may be here remarked that a portion of large intestine in a collapsed state might possess a meso-colon, while the same portion in a distended state, in consequence of the separation of its lateral walls, might show no trace of a meso-colon.

PERITONEAL FOSSÆ

It is now necessary to consider certain fossæ in which knuckles of intestine may be caught and strangulated. The lesser sac has been already mentioned, and has been stated to lie behind the stomach and to pass down in the great omentum in front of the transverse colon. Its opening, the foramen of Winslow, has also been examined. The remaining peritoneal fossæ are found in three regions: (1) near the duodeno-jejunal flexure; (2) near the ileo-cæcal junction; (3) in connection with the pelvic meso-colon.

In order to find the fossæ of the first group, the great omentum and transverse colon must be turned up, and then the whole of the small intestines drawn over to the right.

The *duodeno-jejunal fossæ* may be three in number. They all lie to the left of the terminal portion of the duodenum; they are known as *superior* and *inferior duodeno-jejunal* and *para-duodenal* from their relationship to each

other and to the duodenum. It is exceptional to find them all present and well developed; it is rare, however, to find no trace of any of them. The *para-duodenal fossa* is the fossa at the extreme left. In the free edge of the fold of peritoneum which bounds the fossa anteriorly a large vein is often seen; this vein may be either the inferior mesenteric vein itself, or a large tributary passing down to it from the transverse colon, an accessory middle colic vein.

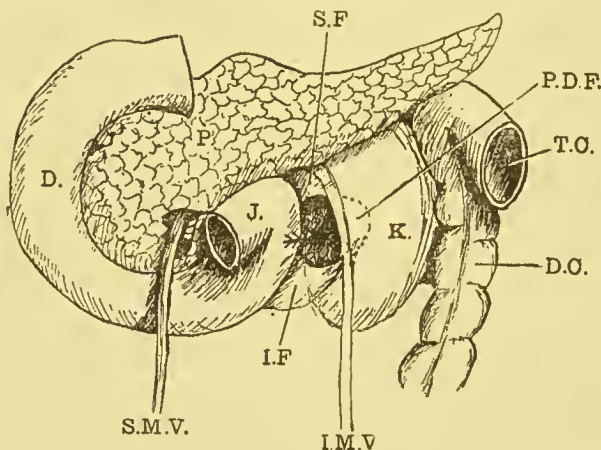


FIG. 243.—THE DUODENO-JEJUNAL FOSSÆ.

P. Pancreas. *D.* Duodenum. *J.* Beginning of Jejunum. *S.M.V.* Superior Mesenteric Vein. *I.M.V.* Inferior Mesenteric Vein. *K.* Kidney. *T.C.* Transverse Colon (cut). *D.C.* Descending Colon. *S.F.* Superior Duodeno-jejunal Fossa. *I.F.* Inferior Duodeno-jejunal Fossa. *P.D.F.* Para-duodenal Fossa (the arrow is directed into this).

The *fossæ* in the *ileo-cæcal* region are again three in number, though, like the duodeno-jejunal fossæ, they are all very inconstant in the adult. In a full-term fœtus the ileo-colic and ileo-cæcal fossæ are always well marked; one, the *ileo-colic*, in front of the angle between the ileum and ascending colon; another, the *ileo-cæcal*, in the angle between the ileum and cæcum; the third, the *retro-cæcal*, behind the cæcum. The fold of peritoneum bounding anteriorly the ileo-colic fossa contains the anterior cæcal branch of the

ileo-colic vessels; the fold bounding the ileo-cæcal fossa usually contains no vessel, and is termed the ileo-appendicular or bloodless fold. In order to see it and its fossa draw the cæcum and ileum forwards with the left hand, and the appendix backwards with the right; this stretches the fold, which passes back from the lower margin of the ileum to the root of the appendix. The fossa is just above the fold. The retro-cæcal fossa passes upward behind the cæcum and ascending colon; when present, it not infrequently contains within it the vermiform appendix (see Fig. 240, R.C.P.).

The fossa in connection with the pelvic colon is known as the *fossa intersigmoidea*, from the name which this portion of gut formerly bore—sigmoid colon. To demonstrate it turn the pelvic colon upwards and to the right, and examine the attachment to the posterior abdominal wall of the pelvic meso-colon. At the highest point of the line of attachment lies the opening of the fossa. The little finger should be passed into the fossa, at the apex of which lies the left ureter (see Fig. 240, P.M.C.).

In addition to the forementioned fossæ two other pouches may be noted; one is for the spleen, while the other is of great practical importance, because of its relation to the gall bladder. The pouch for the spleen is at the left upper corner of the abdomen, and is bounded above and to the left by the diaphragm, below by the phrenico-colic ligament, and to the right by the gastro-splenic omentum and lienorenal ligament. Pass the hand into the pouch and lift the spleen up, when the two peritoneal folds last mentioned will be seen, one passing forward to the stomach, the other backward to the kidney. Both folds contain blood vessels; the gastro-splenic omentum conveying the vasa brevia, branches of the splenic artery, to the fundus of the stomach, while the lienorenal ligament is the fold whereby the splenic vessels pass from the posterior abdominal wall to the spleen (see Fig. 240, L.R.L.).

The *phrenico-colic ligament*, as its name implies, runs

from the splenic flexure of the colon to the diaphragm opposite the eleventh rib; it usually forms a well-marked shelf for the spleen.

The second pouch lies in the corresponding position on the right side. It is known as the right kidney pouch, and is bounded above by the liver, below by the hepatic flexure and transverse colon, to the right by the meeting of the liver and hepatic flexure, to the left by the second portion of the duodenum and the gall bladder below and by the foramen of Winslow above (see Fig. 240, F.W.). The pouch is more potential than real with the viscera *in situ*. Pus not infrequently collects within it from duodenal, gall bladder, or appendicular trouble, and should this pus not be quickly evacuated, it tends to overflow into the general peritoneal cavity, or into the small peritoneal sac through the foramen of Winslow. The opening necessary for drainage is made into the fossa through the right flank immediately to the right of the upper half of the right kidney.

Before leaving the peritoneum note again the direction of the attachment of the mesentery, and how suppuration in connection with the stomach or gall bladder tends to be guided by the mesentery down to the right iliac fossa (Fig. 240, M.).

THE SMALL INTESTINE

Take hold of a loop of the small intestine, and trace it upwards to the left side of the second lumbar vertebra, and downwards to the right iliac fossa. The length of the small intestine is about twenty-three feet. Its length is, however, liable to be materially contracted by the action of formalin with which most bodies are now preserved. It is usual to divide it somewhat arbitrarily into an upper two-fifths, jejunum, and a lower three-fifths, ileum. At the present stage the distinctions between the two parts are: (1) the jejunum lies more to the left of the middle line, the ileum more to the right; (2) the jejunum has thicker walls than

the ileum, due largely to the foldings of its mucous membrane—the valvulae conniventes—being better developed; (3) the jejunum is slightly wider than the ileum. A piece of the small intestine should now be pulled downwards, the mesentery stretched, and the structures between the two layers of peritoneum examined. First look carefully at the mesentery, and in all but very fat bodies some indication will be seen of blood vessels and lymphatic nodes. Next carefully strip off a layer of peritoneum and clean up the blood vessels, lymphatics, and nerves of a portion at least four inches broad. The blood vessels will be seen to be arranged in a very characteristic manner. They run towards the gut, spreading as they go; as they near the gut they divide into ascending and descending branches, which join similar branches from adjacent arteries, forming a series of loops, from which loops other branches arise; these, again, form loops, until there may be a series of three or more loops before the terminal branches are given off. The last branches divide a little distance from the intestine into two relatively small vessels, which run alternately in front of and behind the gut to anastomose with each other on its anterior aspect; they may thus be said to form loops round the gut. The veins have a corresponding course to that of the arteries. The vessels are accompanied by fine nerves and lymphatics (lacteals), passing through a series of lymphatic nodes [lymphoglandulae mesentericae]. These are more numerous in the jejunal than in the ileal portion of the mesentery. Further, although the nodes are scattered through the mesentery from gut to abdominal wall, they are much larger near the parietal than near the visceral attachment. If the artery already dissected in the mesentery be traced to its origin, it will be found to come from the superior mesenteric, a large artery which arises from the aorta at the lower border of the first lumbar vertebra, and pursues a slightly curved course, with its convexity to the left, to the right iliac fossa. From its left side arise several vessels

which run to the small intestine in the way already described—the *rami intestini tenuis*.

Before removing the intestines the method of performing gastro-jejunostomy, or joining the stomach to the jejunum, should be studied. Turn the transverse colon up, and find again the incision previously made in the transverse meso-colon, and identify through it the posterior surface of the stomach. The operation of gastro-jejunostomy consists in making an opening into a loop of jejunum, passing the gut through a hole in the transverse meso-colon, and stitching the margins of the orifice to those of a similar orifice on the posterior wall of the stomach. By this procedure the contents from the stomach are short circuited into the jejunum without having to traverse the pyloric canal and duodenum.

The small intestine should now be ligatured near its beginning and end, divided and removed, cutting through the mesentery one to two inches from its parietal attachment. In this way the direction and relations of the mesentery will be seen. In passing from left to right it crosses the duodenum, aorta, third and fourth lumbar vertebræ, inferior vena cava, right sympathetic cord, right psoas muscle, genito-crural nerve, right ureter, right spermatic vessels, terminating just above the right sacro-iliac joint.

Examination of the Removed Intestines.—Two portions of the highest part of the jejunum, each six inches in length, and two similar portions of the ileum should be taken. One portion of each part should be slit longitudinally along the attachment of the mesentery, and examined under a tap of running water. The other portions should be ligatured, inflated by bellows and hung up to dry. The mucous membrane of the first portions should be carefully scrutinised, when it will be seen to be thrown into a series of folds, some transverse, others oblique—the *valvulæ conniventes* [plicæ circulares]. Further, the surface of the mucous membrane is studded all over with fine papillæ, which are termed villi, and which produce an appearance which has been well likened

to the pile of velvet. If the pieces of jejunum and ileum be compared, the valvulæ and villi will be found to be larger and more distinct in the jejunum. If next the pieces are stretched and held up to the light, one or more dark oval patches may be seen in the ileum but not in the jejunum. These are known as *Peyer's patches* [noduli lymphatici aggregati]. In dissecting-room subjects, who are almost always old, the lymphoid tissue here as elsewhere is usually atrophied. The patches, which are arranged with their long axis in the

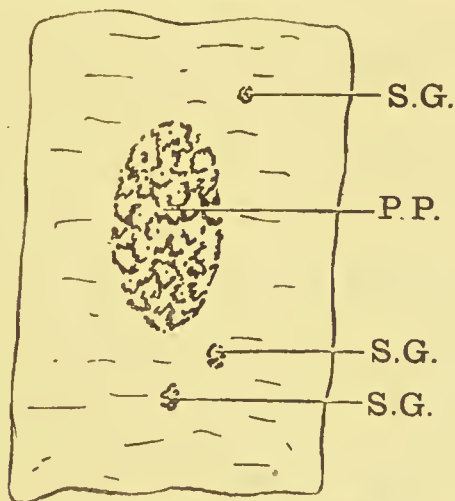


FIG. 244.—A PIECE OF THE ILEUM LAID OPEN TO SHOW A PEYER'S PATCH (P.P.) AND SOLITARY GLANDS (S.G.) IN ITS MUCOUS COAT.

line of the long axis of the gut, consist of aggregations of lymphoid follicles, and are represented in the jejunum by solitary follicles only. By attention to the valvulæ, villi, and patches, it is therefore possible to distinguish a typical piece of jejunum from a typical piece of ileum.¹

THE LARGE INTESTINE

The large intestine should now be traced. It begins in the right iliac region as a cul-de-sac, the cæcum; from this

¹ About three feet from the ileo-cæcal valve there is sometimes found a thimble-like pouch of the ileum, known as Meckel's diverticulum.

it will be seen to pass upward and slightly outward to the under surface of the liver, where, turning to the left, it forms the hepatic flexure, and is continued across the abdominal cavity as the transverse colon to the region of the spleen. Here it bends a second time, forming the splenic flexure, and is thence continued downwards and slightly inwards as the descending colon. Where it crosses the left iliac fossa it becomes the iliac colon, and, at the inner border of the psoas, it passes into the pelvis as the pelvic colon. The latter portion of the large intestine, like the transverse colon, is movable, being suspended from the posterior abdominal wall by a fold of peritoneum, the pelvic meso-colon.

Run the measuring-tape along the large intestine from the cæcum to the rectum and notice its length. In the post-mortem-room it generally measures something over five feet, but in a dissecting-room where formalin is used it may be much less. Notice that there are three points by which a piece of large intestine may be distinguished from small when it is drawn out of an abdominal incision. First and by far the most useful is the presence of the fatty tags or *appendices epiploicæ*, which are present in the whole of the large intestine except the cæcum and end of the rectum. Secondly, the longitudinal muscle is collected into three bands (*teniæ*); and thirdly, the walls show sacculations (*haustæ*). The two latter points are often not well marked until the gut has been inflated and dried.

Turn the transverse colon upwards and remove the lower layer of the transverse meso-colon, exposing thereby the middle colic vessels, lymphatics, and nerves which supply the transverse colon. These should be traced to their origin from the superior mesenteric. The vessels will be found to branch in a manner similar to that in which the vessels to the small intestine branch. Near the hepatic and splenic flexure the vessels enter into anastomoses with branches of the right and left colic respectively. Next remove the transverse colon after carefully ligaturing the ends which are left.

Take care, however, to leave the hepatic and splenic flexures as well as a narrow strip of transverse meso-colon connecting them.

THE STOMACH

Attention must now be directed to the stomach, which should be, if possible, inflated at this stage. This is best accomplished by passing a long india-rubber tube through the mouth into the stomach and blowing along it from a bellows. The stomach will readily be distended, and will probably retain sufficient air without the application of ligatures. If, however, the œsophagus has been exposed in the dissection of the thorax, a slit large enough to receive the nozzle of the bellows may be made in it there. In a body injected with a good deal of formalin, it is hardly worth while trying to inflate the stomach.

The stomach will now be seen to be of a pyriform shape, the *fundus* lying above and to the left, the *pylorus* lying horizontally to the right on the transpyloric line (see p. 79). It is not always easy to see the position of the pylorus, but it may always be felt as a definite thickening if the stomach and duodenum be palpated carefully; it is seldom more than an inch to the right of the mid line. The œsophageal aperture lies to the medial side of the fundus, behind a point on the 7th left costal cartilage, an inch from the sternum.

The index finger should now be passed from the œsophageal aperture to the pyloric aperture along the upper border of the stomach; in this way the *small curvature* of the stomach will be defined, and it will be noted that about two-thirds of the way down it bends much more sharply than elsewhere. The finger should be similarly passed between the two apertures along the lower border defining the *great curvature*. Notice that along the small curvature the gastro-hepatic omentum is attached, along the great curvature the great omentum, and along the fundus the gastro-splenic omentum.

If an opportunity occurs of comparing a distended with a collapsed stomach, it will be noticed that the difference is in the left or cardiac region. That part of the stomach near the pylorus is known as the *pyloric canal*, and enlarges comparatively little when the organ is distended.

Next note that the anterior relations of the stomach are the left lobe of the liver, the anterior abdominal wall, and

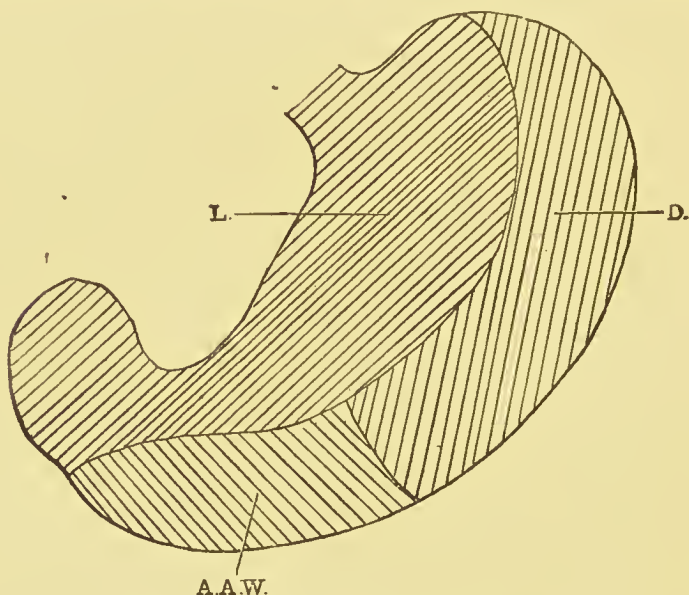


FIG. 245.—ANTERIOR SURFACE OF STOMACH.

L. Liver Area. *D.* Diaphragm Area. *A.A.W.* Anterior Abdominal Wall Area.

the diaphragm. The part which lies against the anterior abdominal wall is of particular importance, since it is the only portion which can be palpated in the living subject.

It can be mapped out in the following manner: An oblique line, from the tip of the 9th costal cartilage on the right side to the tip of the 8th on the left side, gives the lower border of the liver and the upper right limit of the superficial gastric area. The left costal margin limits the

area above and to the left. A curved line from the 9th left costal cartilage to the lower border of the liver, one inch to the right of the middle line, will give the lower border.

Now raise the stomach and study its posterior relations; in other words, the stomach bed. It should be realised, however, from the outset that the removal of the transverse colon and meso-colon, and the underlying coils of intestine, have greatly changed the original conditions. The transverse colon and meso-colon may be said to have formed a more or less horizontal shelf which projected forwards from the posterior abdominal wall; the anterior edge of the shelf was formed by the transverse colon, while the shelf itself was supported from below by the coils of small intestine. By this device the strain to which the stomach is put by the actual weight of the food within it is lessened. On the other hand, any dropping of the small intestines is necessarily followed by a dropping of the transverse colon and meso-colon, and a consequent loss of support to the stomach (Fig. 246).

The remainder of the stomach bed will be seen to be formed by the anterior surface of the pancreas, anterior surface of the left kidney and suprarenal capsule, the gastric surface of the spleen, and the diaphragm. The posterior surface of the stomach is, however, separated from all these structures by the lesser sac. The relations of the viscera here enumerated to the posterior surface of the stomach are of great importance, for the implication of adjoining viscera in pathological conditions of the stomach is not infrequent. In ulceration or perforation of the stomach, for example, inflammation of the pancreas or the cellular tissue around the kidney and under the diaphragm are often associated.

The stomach should now be replaced and its blood vessels and nerves dissected. If the anterior layer of peritoneum along the small curvature be carefully removed, two arteries, with accompanying veins and lymphatics, will be exposed. The artery running from left to right is the *coronary* [*a. gastrica sinistra*]. The artery running in the reverse direction



is the *pyloric* [a. gastrica dextra]. Any lymphatic nodes associated with these vessels must be carefully cleaned and their position noted; they form an important group, called the nodes of the small curvature [lympho-glandulæ gastricæ superiores]. The coronary artery should be traced upwards to the bare area on the posterior surface of the stomach, immediately below the œsophageal aperture. The pyloric

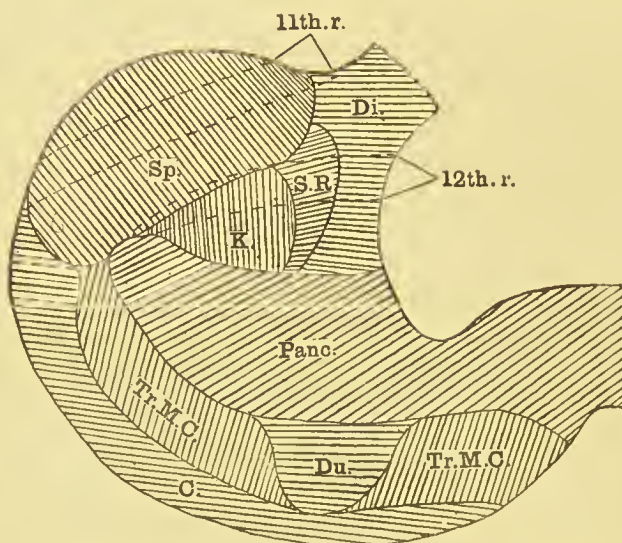


FIG. 246.—THE RELATIONS OF THE POSTERIOR SURFACE OF THE STOMACH.

Di. Diaphragm. *11th* and *12th r.* Corresponding Ribs. *Sp.* Spleen. *K.* Kidney. *S.R.* Suprarenal. *Panc.* Pancreas. *Tr.M.C.* Transverse Meso-colon. *Du.* Duodeno-jejunal Flexure (the Transverse Meso-colon intervening between it and the Stomach). *C.* Transverse Colon.

should be similarly traced to the right, when it will be seen to arise from a large trunk, which will be identified later as the Hepatic. If the peritoneum be now carefully removed from the anterior surface of the œsophagus, a number of nerves will be exposed coming down through the œsophageal aperture of the diaphragm—branches of the left vagus; these branches should be followed along the lesser curvature and over the anterior surface of the stomach. On

the posterior surface of the œsophagus lie branches of the right vagus, but these cannot be seen at present.

Now examine the blood vessels which supply the fundus

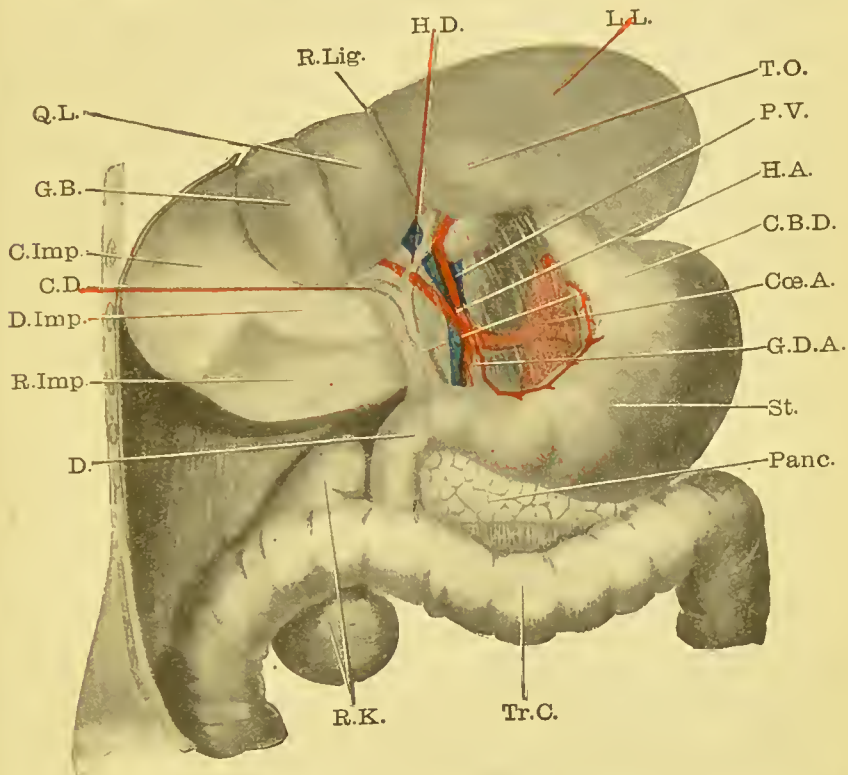


FIG. 247 —THE STRUCTURES IN RELATION TO THE SMALL OMENTUM.

D. Duodenum. *R.Imp.* Renal Impression on the Liver. *D.Imp.* Duodenal Impression on the Liver. *C.Imp.* Colic Impression on the Liver. *C.D.* Cystic Duct. *G.B.* Gall Bladder. *Q.L.* Quadrate Lobe. *R.Lig.* Round Ligament. *H.D.* Hepatic Duct. *L.L.* Left Lobe. *T.O.* Tuber Omentale. *P.V.* Portal Vein. *H.A.* Hepatic Artery. *C.B.D.* Common Bile Duct. *Cœ.A.* Cœliac Axis. *G.D.A.* Gastro-duodenal Artery. *St.* Stomach. *Panc.* Pancreas. *Tr.C.* Transverse Colon. *R.K.* Right Kidney.

of the stomach; remove the anterior layer of the gastro-splenic omentum, thereby exposing the *vasa brevia* [*aa. gastricæ breves*], which come from the splenic vessels; trace the vessels to the right and to the left, to the stomach, and

to their origin from the splenic vessels near the hilum of the spleen. The absence of lymphatic nodes in association with the fundus of the stomach should be noted. Next examine the blood vessels which run along the remainder of the great curvature; these are, on the left, running towards the right, the left gastro-epiploic, a branch of the splenic; and on the right, running to the left, the right gastro-epiploic, a branch of the gastro-duodenal artery from the hepatic. These arteries should be carefully followed, and they will then be seen to send branches upwards on to the stomach and downwards into the great omentum. Along the right gastro-epiploic particularly a number of lymphatic nodes should be sought [lympho-glandulæ gastricæ inferiores]. This chain is still thicker along the lower border of the pylorus, and can be followed upwards behind the pylorus; there thus being a *sub-pyloric* and a *retro-pyloric* group. These groups are of importance because of the frequent incidence of cancer in this region of the stomach.

THE LIVER

At this point it will be convenient to leave the stomach for further consideration later, and to direct attention to the Liver, the largest gland in the body. It has the shape of a pyramid, the base being to the right and the apex to the left. The sides of the pyramid are formed by the superior, inferior, anterior, and posterior surfaces. Of these the superior, anterior, and a part of the inferior can be now studied. The superior and anterior surfaces are divided into two by the falciform ligament. This passes from the superior and anterior surfaces of the liver to the under surface of the diaphragm, and to the anterior abdominal wall, as low as the umbilicus. In its inferior free edge, as has been noticed already, the ligamentum teres or obliterated umbilical vein can be felt. In many cases a small artery and vein can be traced along the ligamentum teres as far as the trans-

verse fissure of the liver; the vein is of practical importance, because it links together the portal and systemic circulations, and is frequently enlarged in cases of obstruction of the portal vein. In the unopened abdomen this falciform ligament lies flat against the anterior abdominal wall, its hepatic attachment being well to the right of the mid line.

The superior surface of the liver is in relation to the diaphragm, which separates it from the two pleural sacs and the pericardium. Near the middle line the superior surface is slightly concave, in consequence of the depression of the diaphragm caused by the pericardium. On either side of this middle portion the superior surface is convex in correspondence to the right and left domes of the diaphragm.

The base or right surface of the liver lies against the diaphragm, which, it should be observed, here separates the liver from the right pleural sac, right lung, and the 7th to the 11th costal arches—the 12th rib does not reach sufficiently far forward to come into relation with this surface of the liver. The base is convex, in conformity with the concavity of the diaphragm into which it fits. The student should therefore realise that a punctured wound may injure the pleura, lung, diaphragm, peritoneum, and liver if inflicted on the lower part of the right side of the thorax.

The apex of the liver lies to the left, against the diaphragm, above the fundus of the stomach, and just behind the 6th left costal arch.

The anterior surface of the liver is of considerable importance, for it is the surface which admits most readily of examination in the living. It passes above, below, and to the right into the superior, inferior, and basal surfaces. It is limited above by a line which, in the medial plane, corresponds with the junction of the gladiolus and ensiform cartilage and passes almost horizontally outwards on the left side, but outwards and upwards on the right side, describing a gentle curve which reaches in the mammary line as high as the 5th

costal arch, or about half an inch below the right nipple; in the mid-axillary line, where it separates the superior surface from the base, the 7th costal arch. It is limited below by a line which coincides with the lower costal margin of the right side as far as the 9th rib, which then passes obliquely from the 9th right to the 8th left, and is continued on to meet the superior limiting line at the apex behind the 6th costal arch. It will now be seen that the liver lies behind the 7th to 11th costal arches inclusive, on the right side separated by the diaphragm, behind the ensiform cartilage and anterior abdominal wall, and behind the 6th to 8th arches inclusive on the left side. The median portion, which lies against the anterior abdominal wall, can be easily palpated, and can therefore yield information as to the state of the liver. It must further be clearly understood that the liver moves downwards in inspiration, and, if the inspiration is forced, almost the whole of the inferior border can be felt.

The inferior surface of the liver looks backwards and to the left as well as downwards. It is in relation from right to left to the right kidney and hepatic flexure, the descending portion of the duodenum, the gall bladder, the upper horizontal portion of the duodenum, the pylorus, and anterior surface of the stomach, including the fundus. The exact position of these relationships should be observed, and it will be seen that the liver is largely moulded by the viscera with which it is in contact. It may be here mentioned that, generally speaking, the solid viscera of the abdomen are more inclined to be moulded by than to mould the hollow ones. The posterior surface of the liver cannot be studied until the organ has been removed.

The liver should now be hooked up so as to expose as much as possible of the inferior surface (see Fig. 247). The free edge of the gastro-hepatic omentum should next be fixed, and the two layers of peritoneum which form it separated. As a result of this procedure the structures lying in the free edge will be exposed; these are the hepatic artery, portal

vein, common bile duct, and accompanying nerves and lymphatics. The artery lies to the left, the duct to the right, and the vein behind and between. These structures should now be traced upward to the transverse fissure of the liver, where the relationship will be found to be duct artery vein from before backward.

A good view will now be obtained of the *Gall Bladder* [vesica fellea], a pyriform sac with its fundus anterior and its apex continued into the *cystic duct*, which joins the hepatic duct by turning sharply to the left near the transverse fissure. This continuity should be now demonstrated, and in doing so carefully preserve any lymphatic nodes which may be found in the course of the duct. A large node usually occupies the angle formed by the sharp bend between the neck of the gall bladder and the cystic duct. The lymphatic nodes at the transverse fissure should be left for the present. Now trace the common bile duct, hepatic artery, and portal vein downwards to the upper border of the first part of the duodenum, noting again how the duodenum in a horse-shoe curve surrounds the pancreas. The close relationship of the gall bladder to the duodenum is very important to notice (see Fig. 248). Ligature the duct and vessels each in two places midway between the transverse fissure and the duodenum, and divide them. If they are next turned aside the posterior wall of the abdomen will be exposed, and lying upon it in this situation is the *inferior vena cava*, which should be cleaned as far upward and downward as possible, ligatured in two places, and divided.¹ The liver should now be allowed to fall back into its original position. If it be further pressed down and the diaphragm pressed up, the anterior layer of the coronary ligament is made tense, and if an incision be made through it, parallel with and just above the right lobe of the liver, a compartment containing loose cellular tissue

¹ In a formalin body it is not so important that the vein should be ligatured.

will be found, from the anterior and posterior walls of which, formed by the liver and diaphragm, the peritoneum is entirely absent. This compartment should be explored by the finger, when its transverse width will be found to correspond to that of the right lobe of the liver. With a

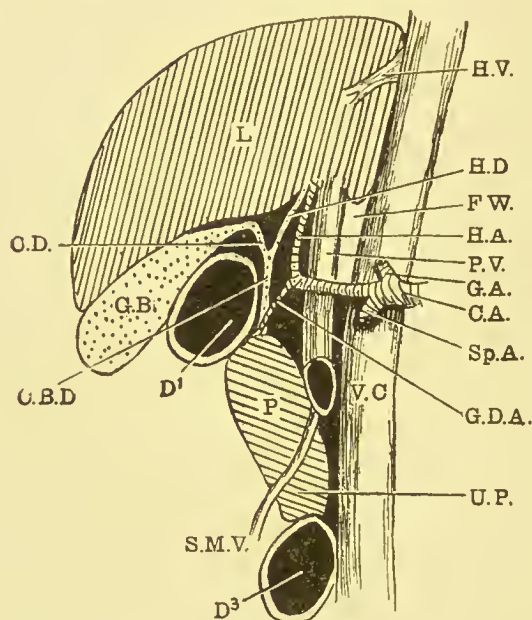


FIG. 248.—DIAGRAM OF A NEARLY ANTERO-POSTERIOR SECTION PASSING THROUGH THE GALL BLADDER AND INFERIOR VENA CAVA.

(This section runs a little outwards as well as forwards.)

L. Liver. *G.B.* Gall Bladder. *C.D.* Cystic Duct. *C.B.D.* Common Bile Duct. *D¹.* Duodenum (First Part). *P.* Pancreas. *S.M.V.* Superior Mesenteric Vein. *U.P.* Uncinate Process. *D³.* Duodenum (Third Part). *H.V.* Hepatic Vein. *H.D.* Hepatic Duct. *F.W.* Foramen of Winslow. *H.A.* Hepatic Artery. *P.V.* Portal Vein. *G.A.* Gastric Artery. *C.A.* Coeliac Axis. *Sp.A.* Splenic Artery. *G.D.A.* Gastro-duodenal Artery. *V.C.* Vena Cava.

pair of scissors cut through the falciform and lateral ligaments, keeping an inch from the liver substance. The liver can now be pulled further down, and the inferior limit of the compartment mentioned above can be seen to be formed by the posterior layer of the coronary ligament. In the left

wall of the compartment formed by the meeting of the two layers of the coronary ligament the inferior vena cava can be felt, and should be exposed and divided. The liver can now be lifted out of its bed, a few touches of the knife to divide the posterior layer of the coronary ligament and the surrounding fascia being all that is further required. Now

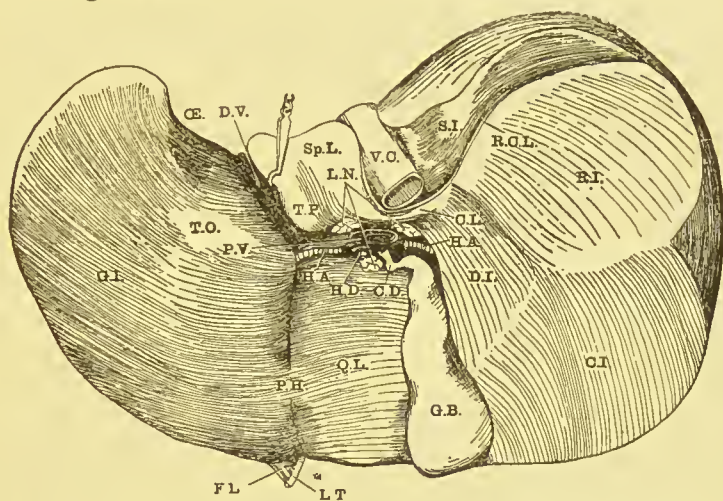


FIG. 249.—THE LIVER LOOKED AT FROM BELOW AND BEHIND SHOWING THE POSTERIOR AND INFERIOR SURFACES.

CE. Esophageal Groove. *D.V.* Fissure of the Ductus Venosus. *Sp.L.* Spigelian Lobe. *T.P.* Tuber Papillare. *L.N.* Lymph Nodes. *V.C.* Vena Cava. *S.I.* Suprarenal Impression. *R.C.L.* Reflexion of the Posterior Layer of the Coronary Ligament. *R.I.* Renal Impression. *C.L.* Caudate Lobe. *H.A.* Hepatic Artery. *C.D.* Cystic Duct. *H.D.* Hepatic Duct. *P.V.* Portal Vein. *T.O.* Tuber Omentale. *G.I.* Gastric Impression. *P.H.* Pons Hepatis. *Q.L.* Quadrangle Lobe. *F.L.* Falciform Ligament. *L.T.* Ligamentum Teres. *G.B.* Gall Bladder. *D.I.* Duodenal Impression. *C.I.* Colic Impression.

study the inferior and posterior surfaces of the liver. Note how artificial is the distinction between the two surfaces, how gradually one fades into the other. Identify the visceral facets on the inferior surface, replacing the liver in its bed if necessary (see Fig. 249). The posterior surface is formed in its central part by an oblong lobe with its long axis vertical, called the *Spigelian lobe*, bounded on the right

by the broad groove for the inferior vena cava, and on the left by the groove for the ductus venosus. Above it passes imperceptibly into the surrounding liver substance, below it ends to the left in a free, rounded swelling—the *tuber papillare*—while to the right it passes by a narrow connection—the *caudate lobe*—into the right lobe of the liver. The posterior surface of this Spigelian lobe is covered by peritoneum of the lesser sac, which separates it from the diaphragm, behind which again is the thoracic aorta. It usually corresponds in level to the tenth and eleventh thoracic vertebræ. To the right of the groove for the inferior vena cava the posterior surface is uncovered by peritoneum and lies against the diaphragm, and at its lower medial angle against the right suprarenal. On the back of the left lobe is a groove for the œsophagus, to the left of which the posterior surface narrows to a rounded border which lies over the fundus of the stomach. This portion of the posterior surface is covered by peritoneum, except along a narrow strip, from the margins of which the peritoneum is reflected on to the diaphragm and continued on the left into the left lateral ligament, just as the meeting of the two layers of the coronary ligament to the right form the right lateral ligament.

The structures at the hilum or transverse fissure of the liver should be now examined. They are the *portal vein*, dividing into a short right and a long left branch; the *hepatic artery*, dividing into its two terminal branches, from the right one of which arises the *cystic artery*, which supplies the gall bladder, the *cystic vein* running to the portal vein; the *common bile duct* [ductus choledochus], formed by the junction of the cystic duct with the hepatic duct. Also at the hilum a careful search should be made for the hepatic plexus of nerves and for the various lymphatic nodes, all of which should be kept. An important relation to observe is that the caudate lobe alone intervenes between the portal vein and the inferior vena cava. All these structures are

embedded in a mass of rather dense cellular tissue, known as *Glisson's capsule* [capsula fibrosa], which is merely a specialised part of the general sub-peritoneal tissue. Prolongations of it are continued into the liver with the vessels.

The gall bladder, cystic duct and common bile duct, so far as it is left attached to the liver, should be slit up by scissors. In doing this notice the S-shaped curve of the cystic duct. The inside of the gall bladder will be found to be lined by a mucous membrane, the surface of which is honeycombed. The cystic duct has its mucous membrane raised to form a valve, which passes spirally along the whole length of the duct [valvula spiralis]. The mucous membrane of the hepatic and common bile ducts is, on the contrary, perfectly smooth. The two hepatic ducts should be traced right into the liver.

The longitudinal fissure should now be examined for two fibrous cords; that in the anterior portion is the ligamentum teres or obliterated umbilical vein; it passes from the umbilicus in the free edge of the falciform ligament to the left branch of the portal vein; that in the posterior portion is the obliterated ductus venosus, which passes from the same branch of the portal vein to the left hepatic vein, and so to the inferior vena cava. In the foetus both these structures are patent and continuous with each other; they convey the pure blood derived from the mother directly from the umbilicus to the inferior vena cava.

The liver should now be laid aside; sections will be later made through it, but it is advisable not to do so at present, since it will be a convenience in studying the relations of adjoining viscera to replace the liver from time to time in its bed.

Having removed the transverse colon, note that its mesocolon is attached across the posterior abdominal wall between the two flexures at the level of the first lumbar vertebra. Immediately above its attachment the whole length of the body of the pancreas can be palpated. Further, the line of the meso-colon passes just above the highest point of the

mesentery proper. By the removal of the transverse colon the lesser sac is opened, and the posterior surface of the stomach is fully exposed.

CÆCUM AND APPENDIX

Attention should now be turned to the region of the junction of small and large intestine. The student is advised to inflate moderately the ascending colon and cæcum by putting the nozzle of the bellows into the hepatic flexure. He will in this way form a clearer idea of the appearance of this portion of the gut during life.

The cæcum will be seen to be a sac measuring in length some 2 inches, in width $2\frac{1}{2}$ inches, occupying fairly completely the right iliac fossa, and tending to overlap the psoas. The ileum opens into it on its postero-medial aspect, while about 1 inch below this opening will be found the base of the vermiform appendix. This, as has been seen already, is often attached to the lower margin of the ileum by the ileo-appendicular or bloodless fold.

The *Appendix* [processus vermiformis] varies a good deal in its position, sometimes pointing downwards and to the left, over the brim of the true pelvis, when it usually comes into relationship with the right ovary in the female. At other times pointing upwards and to the left towards the spleen; sometimes it is directed straight upwards behind the ascending colon, while occasionally it is coiled up in the retro-cæcal fossa.

It is now generally held that the position in which it gains the true pelvis is the commonest; it must be noticed, however, that the appendix seldom forms a straight line, but is bent upon itself at the point where the mesentery, attaching it to the colon and posterior abdominal wall, ends.

The appendix also varies in length; from nothing up to 11 inches. Its average is 3 inches. If it is stretched between the fingers and closely examined, it will be seen

to be covered by a uniform layer of longitudinal muscular fibres. It is attached to the posterior abdominal wall by a reflexion of peritoneum, the *meso-appendix*, which is closely related to the termination of the mesentery and to the reflexion of peritoneum round the cæcum. The meso-

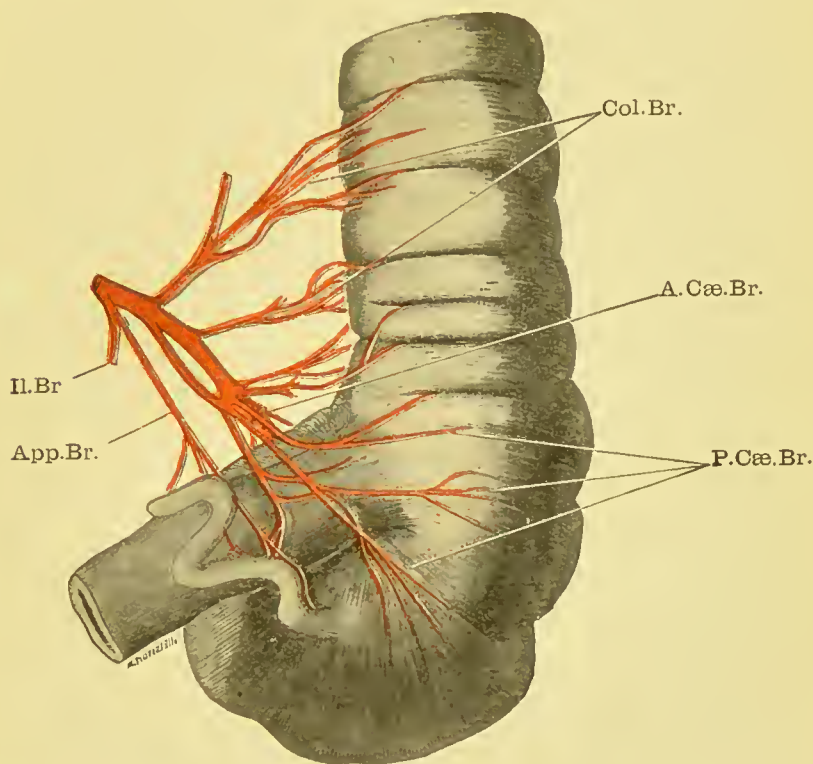


FIG. 250.—POSTERIOR VIEW OF THE CÆCUM WITH ITS ARTERIAL SUPPLY.

Col.Br. Colic Branches. *A.Cæ.Br.* Anterior Cæcal Branch. *P.Cæ.Br.* Posterior Cæcal Branch. *App.Br.* Appendicular Branch. *Il.Br.* Ileal Branch.

appendix contains the small appendicular vessels, which should be traced up behind the ileum to their origin from the ileo-colic.

The cæcum is, as a rule, completely invested by peritoneum, although in certain cases the reflexion of peritoneum

from its posterior surface is such that the upper part of this surface is left bare. Further, it should be noticed that the longitudinal museular fibres at the base of the appendix cease to be uniformly distributed round the gut, but are largely massed together to form the three *tæniæ coli*; a close inspection, however, will show that between the *tæniæ* the long fibres are still present, though faint. In the case of the cæcum, as also in the cases of the ascending and descending colons, the best-marked *tænia* is anterior, the two others being postero-medial and postero-lateral respectively. It follows from this that any one of the three *tæniæ* will serve as a guide to finding the appendix. The blood vessels of the cæcum should be now dissected, and any lymphatic nodes found in their course preserved. The arteries to the cæcum are two main vessels, one lying in front of the viscus, the *anterior cæcal*; the other, the *posterior cæcal*, behind (see Fig. 250). They are derived from the ileo-colic branch of the superior mesenteric, to which we have already traced the appendicular artery, and which will be now seen to break up into its various branches within the termination of the mesentery. Next carefully note the *relations of the cæcum*. They are as follows: *Anteriorly*, the anterior abdominal wall and frequently coils of ileum when the cæcum is empty. *Posteriorly*, the iliac fossa, iliacus muscle, iliac fasciæ, the iliac divisions of the ilio-lumbar vessels, the external cutaneous nerve (see Fig. 251). *Externally*, the iliac fossa. *Internally*, coils of ileum, appendix, psoas muscle, anterior crural, and genito-crural nerves. When the cæcum becomes distended, the internal relations tend to become posterior.

The cæcum reaches below to the outer half of Poupart's ligament; above, to the level of the intertubercular line, which lies 1 to 2 inches below the highest point of the iliac crest. It is useful to remember that the ileo-cæcal junction corresponds to the outer border of the psoas as well as to the mid-Poupart line, and lies about 1 inch external to the line of the sacro-iliac joint.

The position and relations of the appendix are, as already stated, subject to great variation.

The cæcum should now be opened on the side away from

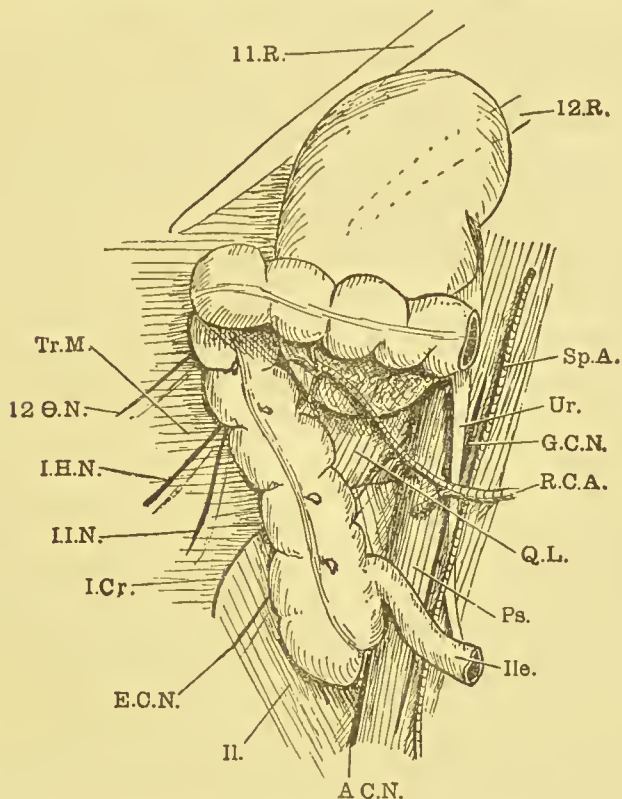


FIG. 251.—DIAGRAM OF THE RELATIONS OF THE RIGHT HALF OF THE POSTERIOR ABDOMINAL WALL.

11 *R.*, 12 *R.* Corresponding Ribs. *Tr.M.* Transversalis Muscle. 12 Θ .*N.* 12th Thoracic Nerve. *I.H.N.* Ilio-Hypogastric Nerve. *I.I.N.* Ilio-inguinal Nerve. *I.Cr.* Iliac Crest. *E.C.N.* External Cutaneous Nerve. *Il.* Iliacus. *Sp.A.* Spermatic Artery. *Ur.* Ureter. *G.C.N.* Genito-crural Nerve. *R.C.A.* Right Colic Artery. *Q.L.* Quadratus Lumborum. *Ps.* Psoas. *Ile.* Ileum. *A.C.N.* Anterior Crural Nerve.

the ileo-cæcal junction, and the ileo-cæcal aperture examined from the inside. The orifice will be seen to be a horizontal slit, and to be bounded by two protuberant lips, which on distension of the cæcum meet and so close the aperture. These

lips form the *ileo-cæcal valve* [valvula coli], which in the living subject is usually competent, and prevents the regurgitation of food from the large into the small intestines.

Notice how much larger and more horizontal the upper lip of the valve is. The lower is oblique, and is practically formed by the wall of the ileum.

Below the ileo-cæcal aperture will be seen that of the appendix guarded by a slight valvular swelling of the mucous membrane [valvula processus vermiformis]. A fine probe should be passed through the orifice and along the appendix, which latter should then be longitudinally divided upon the probe and its interior examined. The thickness of the walls and the smallness of the lumen will then be apparent. The thickness is due to the accumulation of lymphoid tissue [noduli aggregati processus vermiformis]. The ascending colon should now be ligatured below the iliac crest immediately above the ileo-cæcal junction and the terminal portion of the ileum, the cæcum, and appendix removed, noting any peculiarity in the shape, peritoneal relations, or blood vessels of parts. The posterior relations of the cæcum already given should be carefully and systematically confirmed.

THE ASCENDING COLON AND HEPATIC FLEXURE

The student must now direct his attention to the ascending colon and hepatic flexure. Its direction and sacculated appearance have been already noticed. The ascending colon will now be seen to begin just above the ileo-cæcal junction, and to end in an interval between the right lobe of the liver antero-externally and the outer border of the kidney postero-internally. Between its origin and termination it passes upwards and slightly outwards along a sinuous line, which runs more or less parallel with the inferior vena cava for four or five inches. Its posterior relations are the ilium, iliacus muscle, iliac fascia, ilio-lumbar vessels, external cutaneous

nerve, quadratus lumborum, anterior lamella of lumbar fasciæ, the last lumbar vessels, ilio-inguinal and ilio-hypogastric nerves and transversalis muscle. The liver and kidney exclude it from coming into direct relation with the diaphragm. The ascending colon is in relation anteriorly to the anterior abdominal wall, coils of small intestine, liver, and beginning of transverse colon. To the right lies the abdominal wall; to the left coils of small intestine, transverse colon, and kidney (see Fig. 251).

The hepatic flexure is the broad bend which the large intestine forms at the junction of the ascending and transverse colon. It lies in front of the kidney and under cover of the liver and gall bladder. After these relations of the large gut have been noted, the peritoneal covering and the blood vessels should be examined. In the vast majority of cases the peritoneum only covers the ascending colon anteriorly and laterally, the posterior surface being left bare. The chief artery to this portion of the colon is the *right colic*, a branch of the superior mesenteric, which anastomoses below with the colic branch of the ileo-colic, and above with the right branch of the middle colic. The right colic artery when present runs horizontally outwards from the line of the mesentery, its upper branch passing in front of the lower pole of the kidney. The artery should be traced, its distribution, and its single tier of arches and anastomoses fully exhibited. Its terminal branches reach the gut along its bare area, and run circumferentially round it. It is by no means uncommon to find this right colic artery absent, and its work done by the ileo-colic and middle colic.

THE SPLENIC FLEXURE AND DESCENDING COLON

If attention is now turned to the splenic flexure it will be noticed that, compared with the hepatic flexure, it forms a much sharper bend; further, in consequence of the absence of the liver from the left upper region of the abdomen, the

splenic flexure reaches a higher level and a deeper plane. It is limited above by the tail of the pancreas and the base of the spleen; while it rests behind upon the outer border of

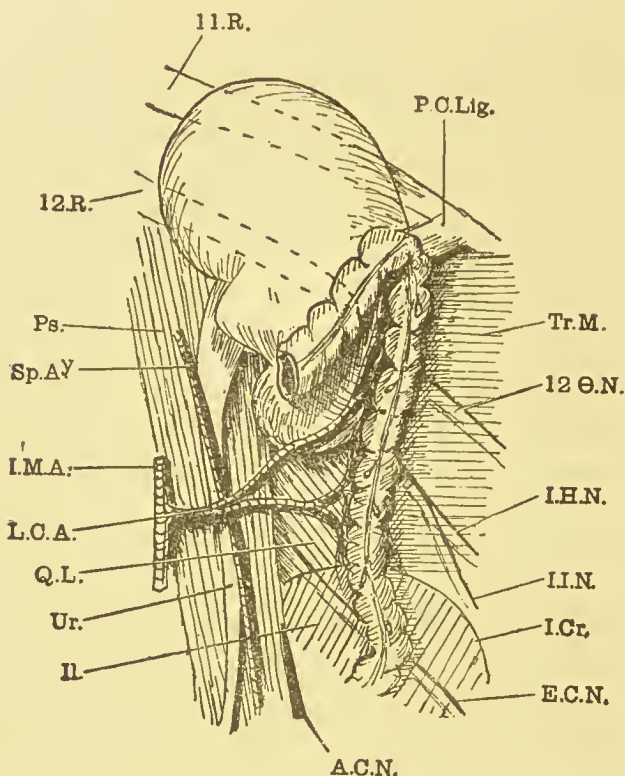


FIG. 252.—DIAGRAM OF THE RELATIONS OF THE LEFT HALF OF THE POSTERIOR ABDOMINAL WALL.

11 R. Eleventh Rib. 12 R. Twelfth Rib. Ps. Psoas. Sp.A.v. Spermatic Artery. I.M.A. Inferior Mesenteric Artery. L.C.A. Left Colic Artery. Q.L. Quadratus Lumborum. Ur. Ureter. Il. Iliacus. A.C.N. Anterior Crural Nerve. E.C.N. External Cutaneous Nerve. I.Cr. Iliac Crest. I.I.N. Ilio-inguinal Nerve. I.H.N. Ilio-hypogastric Nerve. 12 Θ.N. Twelfth Thoracic Nerve. Tr.M. Transversalis Muscle. P.C.L. Phrenico-colic Ligament.

the kidney, and upon the diaphragm and transversalis arising from the 11th rib near its tip. The phrenico-colic ligament binding the splenic flexure to the diaphragm has been noticed already (see Fig. 252).

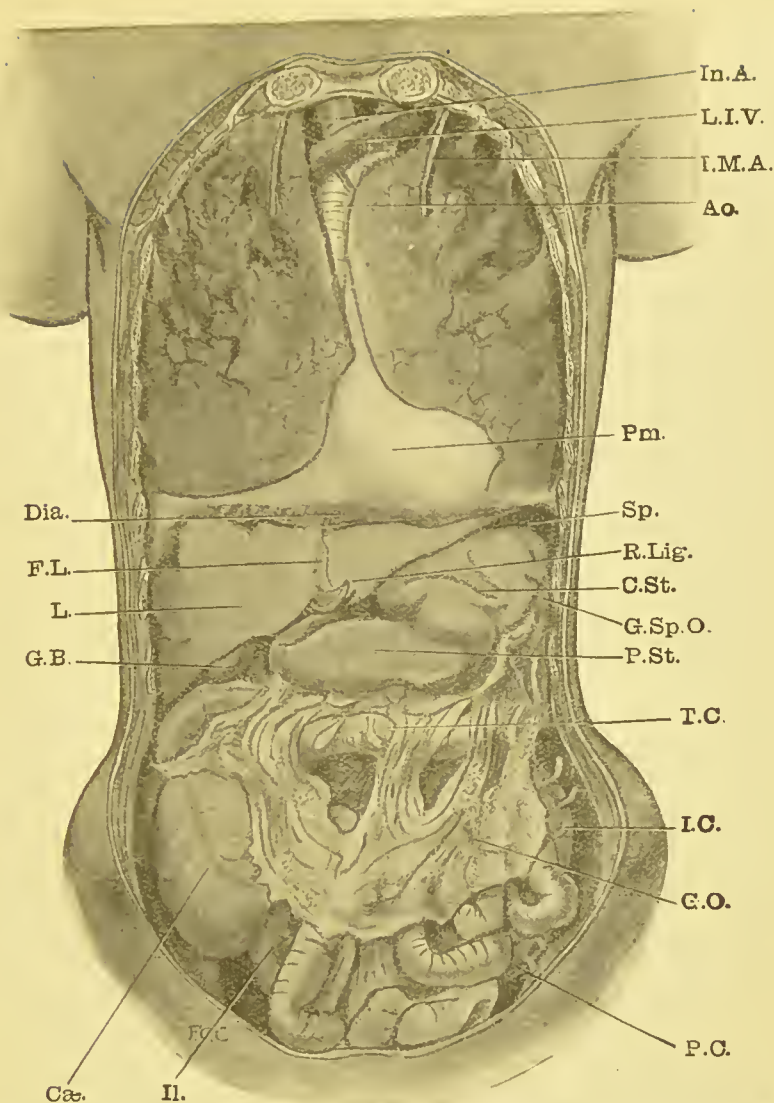


FIG. 253.—HARDENED VISCERA UNDISTURBED AFTER REMOVAL OF THE FRONT OF THE BODY WALL.

In.A. Innominate Artery. *L.I.V.* Left Innominate Vein. *I.M.A.* Internal Mammary Artery. *Ao.* Aorta. *Pm.* Pericardium. *Dia.* Diaphragm. *F.L.* Falciform Ligament. *L.* Liver. *G.B.* Gall Bladder. *Sp.* Spleen. *R.Lig.* Round Ligament. *C.St.* Cardiac Portion of Stomach. *G.Sp.O.* Gastro-splenic Omentum. *P.St.* Pyloric Portion of Stomach. *T.C.* Transverse Colon. *I.C.* Iliac Colon. *G.O.* Great Omentum (two cuts have been made in it to show the Transverse Colon). *P.C.* Pelvic Colon. *Cæ.* Cæcum. *Il.* Ileum.

The relations of the descending colon are very similar to those of the ascending, the chief difference being that it ends on reaching the iliae crest. It runs downwards and inwards along a sinuous line lying upon the transversalis, quadratus lumborum, ilio-hypogastric, and ilio-inguinal nerves and the last lumbar vessels. It reaches the iliae crest near the outer border of the psoas.

Its peritoneal relations are similar to those of the ascending colon, although it is not so uncommon to find that the peritoneum completely surrounds it. The probable explanation of this is that, while the ascending colon is always distended with gas, the descending is closely contracted, and only about half the calibre of the ascending.

The ILIAC COLON is the continuation of the descending colon, and lies in the left iliac fossa, at first not far from the crest, but parallel to the outer half of Poupart's ligament later on (see Fig. 253). It is in this region that the gut is opened in the modern operation of colotomy. Examine it carefully, and notice how closely it is bound to the iliac fossa; usually there is no meso-colon at all, but if one is present it is always very short. As the appendices epiploicæ are well marked, there should be no danger of mistaking a coil of small intestine for this colon in performing a colotomy operation.

THE DUODENUM AND PANCREAS

The duodenum and pancreas should now be studied. Identify the pyloric orifice by pressure between the finger and thumb; the orifice is situated at the point where the resistance to the fingers suddenly changes. This point is situated on the transpyloric plane already defined (p. 79), and lies $\frac{1}{2}$ inch to $1\frac{1}{2}$ inch to the right of the median plane. From its origin the duodenum passes first backwards and to the right to the neck of the gall bladder; it then turns downwards, lying to the right of and behind the gall bladder, until

it reaches the level of the subcostal plane at the third lumbar vertebra, at which level it passes from right to left across the vertebral column; it then turns upwards behind the stomach to the level of the 2nd lumbar vertebra on the left side, at which point it bends sharply forwards to form the duodeno-jejunal flexure.

It will thus be seen that the duodenum, some nine or ten inches in length, forms a horse-shoe-like curve, with its

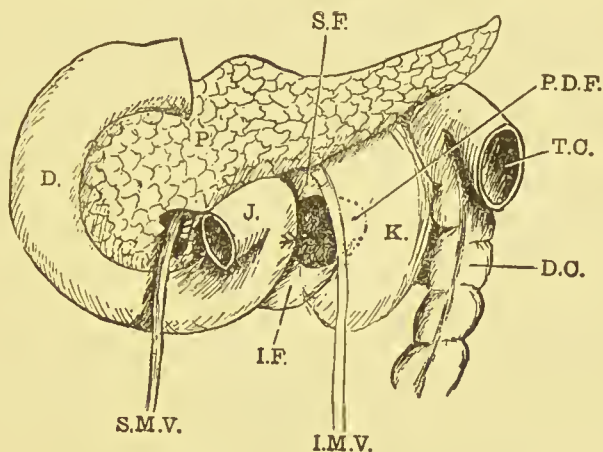


FIG. 254.—THE DUODENO-JEJUNAL FOSSÆ.

P. Pancreas. *D.* Duodenum. *J.* Beginning of Jejunum. *S.M.V.* Superior Mesenteric Vein. *I.M.V.* Inferior Mesenteric Vein. *K.* Kidney. *T.C.* Transverse Colon (cut). *D.C.* Descending Colon. *S.F.* Superior Duodeno-jejunal Fossa. *I.F.* Inferior Duodeno-jejunal Fossa. *P.D.F.* Para-duodenal Fossa (the arrow is directed into this).

opening upwards and to the left, surrounding the head of the pancreas. Four parts of it are usually recognised, the first horizontal lying in close relation to the gall bladder, and having the gastro-duodenal artery, common bile duct, and portal vein behind it (see Fig. 255). The second part runs vertically downwards in front of the hilum of the right kidney, and is covered in front by the fundus of the gall bladder, the liver, the beginning of the transverse colon, and the meso-colon.

The third part runs horizontally to the left, lying in front of the vena cava, aorta, and third lumbar vertebra, and having the transverse colon and superior mesenteric vessels in front of it (see Fig. 255, D³.); while the fourth part

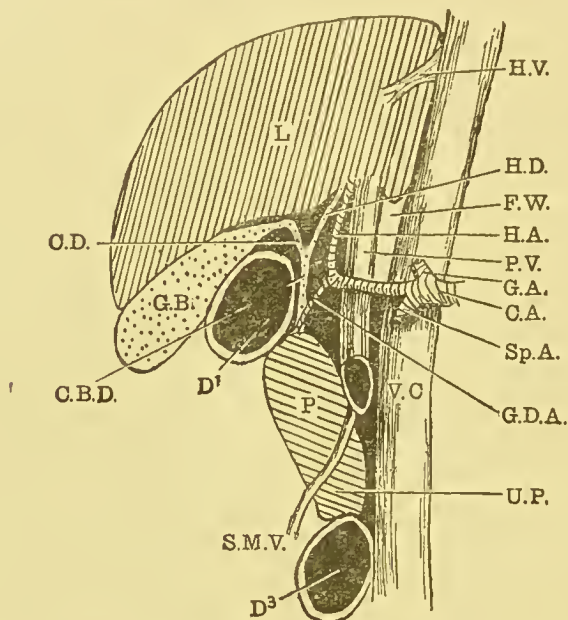


FIG. 255.—DIAGRAM OF A NEARLY ANTERO-POSTERIOR SECTION PASSING THROUGH THE GALL BLADDER AND INFERIOR VENA CAVA.

(This section runs a little outwards as well as forwards.)

L. Liver. *G.B.* Gall Bladder. *C.D.* Cystic Duct. *C.B.D.* Common Bile Duct. *D¹*. Duodenum (First Part). *P.* Pancreas. *S.M.V.* Superior Mesenteric Vein. *U.P.* Uncinate Process. *D³*. Duodenum (Third Part). *H.V.* Hepatic Vein. *H.D.* Hepatic Duct. *F.W.* Foramen of Winslow. *H.A.* Hepatic Artery. *P.V.* Portal Vein. *G.A.* Gastric Artery. *C.A.* Coeliac Axis. *Sp.A.* Splenic Artery. *G.D.A.* Gastro-duodenal Artery. *V.C.* Vena Cava.

ascends from the left side of the third to that of the second lumbar vertebra. This part has the jejunum in front, and the psoas and left sympathetic nerve behind. It is not possible at present to see all the posterior relations given above, since the second, third, and fourth parts of the duo-

denum are retro-peritoneal, and cannot at present be drawn aside. Most of the posterior relations, however, are large structures, and may be identified by the finger.

Occupying the concavity of the duodenum, limited to the right by the descending portion, and projecting beyond the duodenum to the left, lies the *Pancreas*, a flattened, tongue-like viscus 5 to 6 inches long, with its right end or head enlarged and curved, like a shepherd's crook, around the superior mesenteric vessels, its left end or tail tapering to a pointed extremity, which is in intimate relation to the spleen. It has in front of it the stomach, and forms, as has been seen, an important part of the "stomach bed."

That part of the pancreas which lies between the pylorus above and the duodeno-jejunal flexure below, that is to say, between the two ends of the duodenal horse-shoe, is known as the neck because it is more constricted than the rest of the organ; it is only about half an inch from side to side. All the rest of the pancreas from the neck to the tapering tail is spoken of as the body.

Before making any further dissection, notice carefully the peritoneal relations of the parts.

The first part of the duodenum has peritoneum of the greater sac in front and of the lesser sac behind, but when the second part is reached the peritoneum is often lifted off the front for quite a large area by the beginning of the transverse colon, and there is no peritoneum behind, for here the duodenum is in contact with the hilum of the kidney. From the middle of the second part to the duodeno-jejunal flexure the tube is covered in front by the great sac, except where the root of the mesentery crosses it obliquely from above downwards and to the right. The pancreas is covered for the most part by the lesser sac; but if the divided transverse meso-colon be carefully looked at, it will be seen that its lower or posterior layer, which belongs to the great sac, turns downwards and covers the front of the lower part of

the head as well as a narrow strip of the lower part of the body (see Fig. 240, p. 120, P¹. and P²).

Now follow the outline of the pancreas a little more carefully, noticing that the tortuous splenic artery runs from the

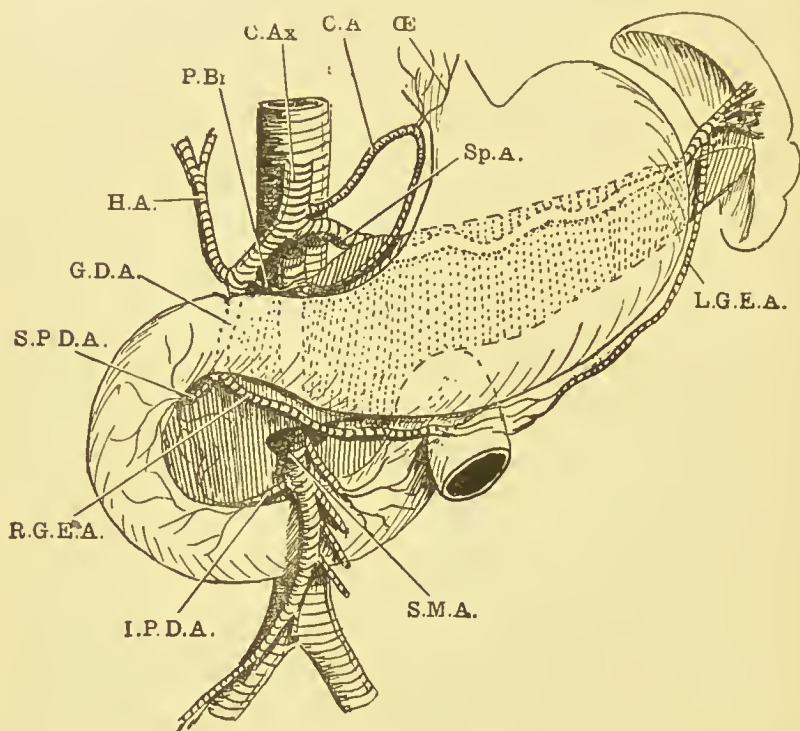


FIG. 256.—THE CELIAC AXIS AND SUPERIOR MESENTERIC ARTERIES.

C.Ax. Cœliac Axis. *C.A.* Coronary Artery. *Æ.* CEsophageal Branches. *Sp.A.* Splenic Artery. *H.A.* Hepatic Artery. *P.Br.* Its Pyloric Branch. *G.D.A.* Gastro-duodenal Artery. *S.P.D.A.* Superior Pancreatico-duodenal Artery. *I.P.D.A.* Inferior Pancreatico-duodenal Artery. *R.G.E.A.* Right Gastro-epiploic Artery. *L.G.E.A.* Left Gastro-epiploic Artery. *S.M.A.* Superior Mesenteric Artery.

cœliac axis along the upper border of the gland to the spleen (see Fig. 256). Notice, too, that on the upper border, just to the left of the neck, is a swelling where the pancreas presses against the lesser omentum above the lesser curvature of the stomach. This *tuber omentale*, as it is called, is in contact

with the tuber omentale hepatis, the lesser omentum alone separating them.

Follow the superior mesenteric vessels up to the place at which they disappear behind the pancreas [incisura pancreatis], and notice how the "crook-like" part of the head of the gland is bent round to the right of and then behind them. This part is well named the *processus uncinatus*.

THE SPLEEN

It is now convenient to examine the position and relation of the spleen, an organ to which the dissector has been led already by the splenic flexure of the colon, the tail of the pancreas and the splenic vessels. It is 5 to 6 inches in length, with its long axis coincident with the posterior part of the 10th rib. It lies in the epigastric and left hypochondriac regions, and has an upper and lower extremity or pole, an outer [facies diaphragmatica], antero-internal [f. gastrica], and postero-internal [f. renalis] surface, an anterior, intermediate, and posterior border (see Fig. 257). The upper extremity is in relation to the left suprarenal capsule close to the vertebral end of the 10th rib. The lower pole is supported by the phrenico-colic ligament, which passes from the splenic flexure of the colon to the diaphragm. It is important to notice that this lower pole is the most anterior part of the spleen, and comes forwards as far as the mid-axillary line. The outer surface is convex and lies against the diaphragm, which separates it from the pleural sac, lung, and 9th, 10th, and 11th costal arches. The antero-internal surface is concave for the posterior surface of the stomach. On this surface, just anterior to the intermediate border, is the slit-like hilum for the splenic vessels. The postero-internal surface is also concave for the upper part of the external border of the kidney. The anterior border usually exhibits two or three notches. As a rule, the posterior border is not notched. The intermediate border separates the antero-internal from

the postero-internal surface. It therefore lies between the stomach in front and the kidney behind. It is near the lower end of this border that the tail of the pancreas touches the spleen, though the area of contact varies greatly. Occa-

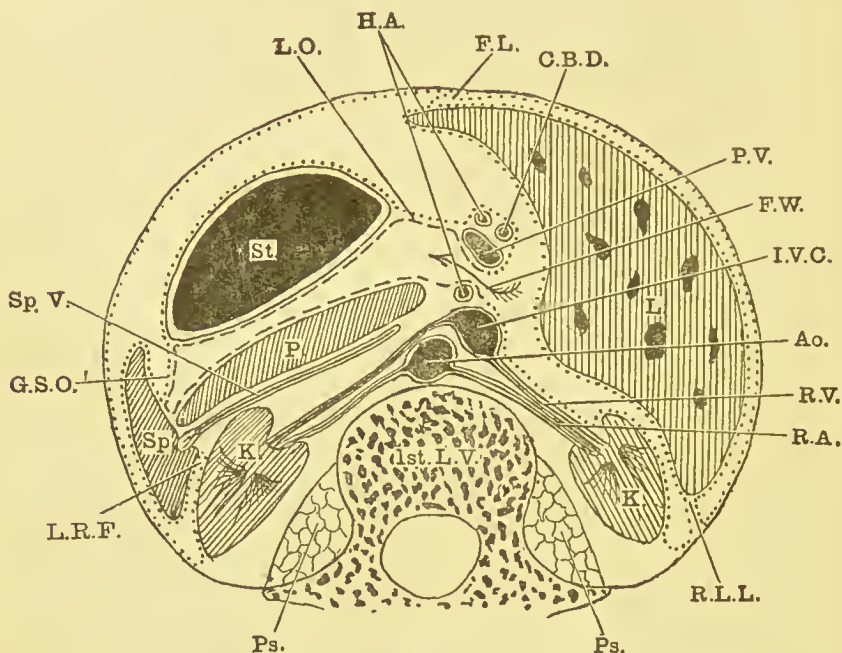


FIG. 257.—DIAGRAMMATIC SECTION THROUGH THE FIRST LUMBAR VERTEBRA TO SHOW THE REFLEXIONS OF THE PERITONEUM.

F.L. Falciform Ligament. *H.A.* Hepatic Artery. *C.B.D.* Common Bile Duct. *P.V.* Portal Vein. *F.W.* Foramen of Winslow. *I.V.C.* Inferior Vena Cava. *L.* Liver. *Ao.* Aorta. *R.V.* Renal Vein. *R.A.* Renal Artery. *R.L.L.* Right Lateral Ligament of Liver. *K.* Kidney. *Ps.* Psoas. *L.R.F.* Lienorenal Fold (the Pancreas has lifted off the other Layer of the Lienorenal Ligament). *Sp.* Spleen. *G.S.O.* Gastro-splenic Omentum. *Sp.V.* Splenic Vein. *St.* Stomach. *L.O.* Lesser Omentum.

sionally the intermediate border of the spleen bifurcates below the hilum in order to enclose a triangular space (basal triangle) for the colon. It seems that, with a contracted stomach, the left part of the transverse colon rises and makes an impression on the spleen, and that the shape of the spleen

varies from hour to hour in the living body, depending on the fulness of the stomach and colon.

If the right hand be passed into the pocket for the spleen and the gland lifted forward, it will be found to be attached posteriorly to the anterior surface of the kidney by a fold of

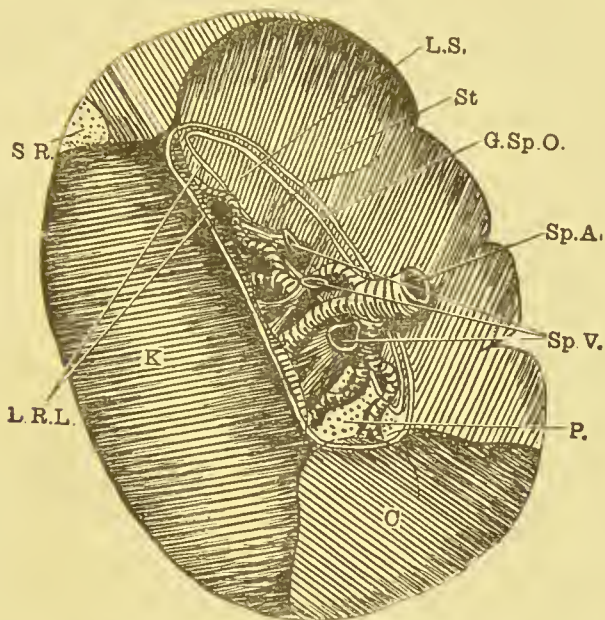


FIG. 258.—THE INTERNAL OR VISCERAL ASPECT OF THE SPLEEN.

S.R. Suprarenal Area. *L.S.* Area covered by Lesser Sac. *St.* Gastric Area. *G.Sp.O.* Two Layers of Gastro-splenic Omentum. *Sp.A.* Splenic Artery. *Sp.V.* Splenic Vein. *P.* Pancreatic Area. *C.* Basal Triangle for Colon. *K.* Renal Surface. *L.R.L.* Reflexion of Lieno-renal Ligament.

peritoneum, the lienorenal ligament, between the layers of which lie the splenic vessels.

These relationships having been studied, clean up the splenic artery [*a. lienalis*] and follow its branches to the pancreas, stomach, and spleen. The branches to the pancreas [*rami pancreatici*] arise from the artery at irregular intervals and enter the upper border of the pancreas; the branches to the spleen [*rami lienales*] become distinct within the

hilum; the branches to the stomach are the *left gastro-epiploic*, which runs along the great curvature from left to right and a number of small branches, *vasa brevia* [*aa. gastricae breves*], which run in the gastro-splenic omentum to the fundus. Make an incision into the substance of the spleen, and notice that there is a definite sheath, within which is the splenic pulp, of a deep brownish-red colour. Scattered among this are lighter points, which are the *Malpighian bodies* (see Fig. 259).

The splenic vein [*v. lienalis*] should now be traced from



FIG 259.—THE NAKED EYE APPEARANCE OF A SECTION OF THE SPLEEN.

the hilum to where it passes behind the pancreas; lymphatic nodes or vessels accompanying the splenic vessels should be kept; they are not numerous, the gastro-splenic omentum being almost devoid of them. Not infrequently small additional spleens are met with.

POSTERIOR ABDOMINAL VISCERA

The student should next remove in one piece the duodenum, pancreas, and spleen, with their associated vessels and the common bile duct. Begin by ligaturing the duodenum immediately beyond the pylorus, divide the duodenum distal to the ligature, and turn it, the portal vein, gastro-duodenal

artery, common bile duct and the head of the pancreas forward to the mid line, being careful of the structures lying behind. If possible leave the portal vein and its constituents in the abdomen in order to study them later; to do this divide the splenic vein near the spleen before the inferior mesenteric vein has joined it. The superior mesenteric vein may be cut as it is passing through its notch in the head of the pancreas. Turn in a similar manner the spleen, the body of the pancreas, the splenic vessels and the duodeno-jejunal flexure forward to the mid line, when, after division of the splenic, hepatic and superior mesenteric arteries, the whole of the associated structures may be removed from the body, and can be readily cleaned in front and behind. The common bile duct may be followed to its opening into the second part of the duodenum, and the *pancreatic duct* found piercing the duodenal coats near the same spot. This duct should be traced into the pancreas, where it can be readily recognised by the whiteness of its walls. Opening into the duodenum an inch nearer the pylorus, an *accessory duct* (of Santorini) is sometimes to be found. The wall of the duodenum opposite the opening of the ducts should be incised, and a search made for the common orifice of the common bile duct and the pancreatic duct. The orifice is situated on a small papilla under cover of a hood-like *valvula connivens*. A bristle should now be passed from the duodenum into each of the ducts, which will show that, although they have a common orifice, the ducts pierce the outer coats of the duodenum separately, uniting within the thickness of the wall.

Continue the incision to the pyloric end of the gut, and notice that the *valvulae conniventes* begin about an inch from the pylorus. Now turn the specimen over to notice the absence of peritoneum behind the duodenum and pancreas, and, having done this, dissect away the muscular from the mucous coat of the pyloric end of the stomach and first part of the duodenum, as in Fig. 260. This will show the presence of Brunner's Glands [Gl. duodenales] in the duodenum as

well as their absence in the stomach. The specimen should now be put carefully aside, for, as in the case of the liver, it is of great advantage in studying the relations of deeper

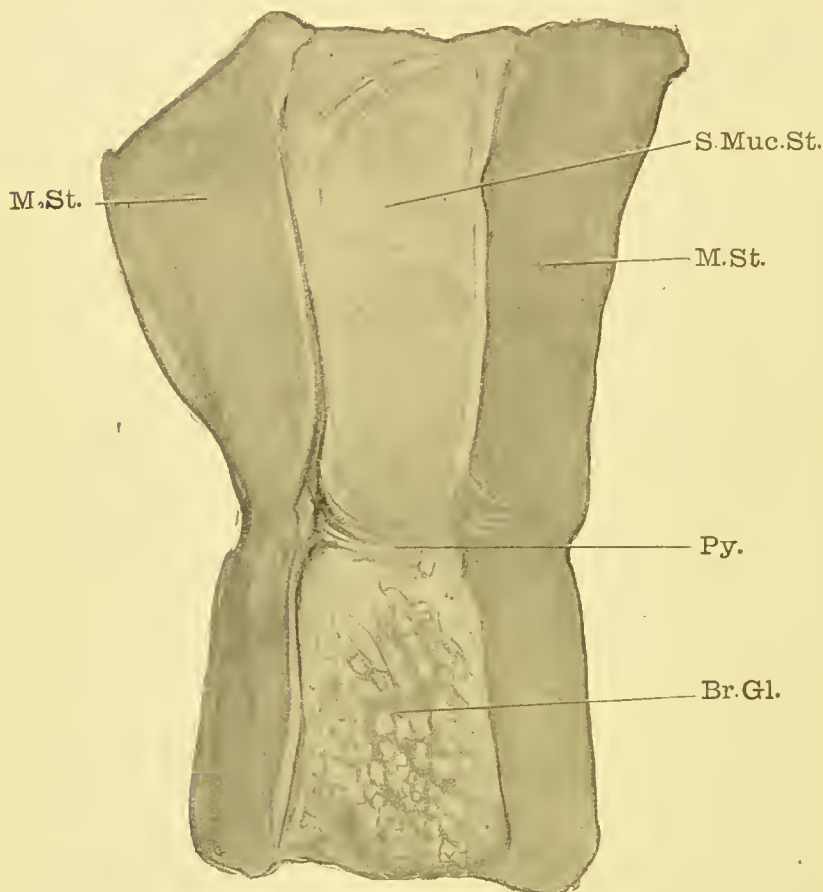


FIG. 260.—DISSECTION OF PYLORIC REGION.

M.St. Muscular Coat of Stomach which has been reflected off at *S.Muc.St.* to show the Submucous Tissue. *Py.* Pylorus. *Br.Gl.* Brunner's Glands seen through the Submucous Tissue.

structures to be able to replace *in situ* the more superficial. The removal of the specimen will have exposed a number of highly important structures, viz. on either side the suprarenal capsules and kidneys with their hila and blood vessels. Near the middle line lies the abdominal aorta between the

two crura of the diaphragm. The inferior vena cava will be seen lying in front of the right crus, while directly in front of it lies the portal vein, both veins having been necessarily cut when the liver was removed.

It will be seen that the portal vein is formed by the junction of the superior mesenteric and splenic veins behind the head of the pancreas and opposite the right side of the second lumbar vertebra.

On tracing what is left of the splenic vein along to the left, the inferior mesenteric vein will be seen to enter it, though the exact point of junction is variable.

Notice that the portal vein drains the whole of the abdominal portion of the alimentary canal, the spleen, and the pancreas.

Slit open the veins of the portal system for some distance in order to notice the absence of valves in them, and then turn them downwards out of the way.

The two crura of the diaphragm unite in front of the aorta, at the level of the twelfth thoracic vertebra, to form the tendinous middle arcuate ligament [hiatus aorticus]. Just below this the *cœliac axis* [arteria cœliaca] will be found dividing after a course of about half an inch into the hepatic, splenic, and coronary or gastric arteries, all of which have now been studied. This axis lies behind the lesser sac of the peritoneum, the posterior layer of which should be carefully dissected away to expose it.

Surrounding the axis will be found a network of nerve fibres forming the great *solar plexus* [pl. cœliacus], containing many ganglia, two of which, the *semilunar ganglia* [g. cœliaca], are placed, one on either side, in front of the crura of the diaphragm.

Into the upper part of each of these ganglia the *great splanchnic nerves*, which have passed through the crura from the thorax, may be traced, while just below the origins of the renal arteries are two more ganglia, the *aortico-renal*, one on either side. If the part is in good condition it will

be seen that each semilunar ganglion is connected with its suprarenal gland by a very large number of nerves of considerable size (see Fig. 261).

The solar plexus sends offshoots along all the arteries of the abdomen, and it is owing to the presence of this great plexus that a blow on the "pit of the stomach" is so dangerous.

Between the two crura to the right of the aorta will be found the *right ascending lumbar vein*, and between the aorta and vein the *thoracic duct* and *receptaculum chyli*. The ascending lumbar vein on the left side pierces the corresponding crus.

The parts now seen and already mentioned should be carefully cleaned preparatory to removing them *en masse*. Begin by cleaning the suprarenal capsules and the kidneys, tracing their arteries to their origin and their veins to their destination, and carefully preserving the nerves and ganglia of the solar plexus. Next clean the inferior vena cava and aorta from where the latter enters the abdomen to just above its bifurcation, tracing the tributaries of the one and the branches of the other as far as possible. The tributaries of the inferior vena cava are, from above downwards:—

(1) *The Hepatic Veins*, to be seen in that part of the vessel removed with the liver.

(2) *The Inferior Phrenic*.

(3) *The Capsular*.

(4) *The Renals*.

(5) *The Right Spermatic or Ovarian*.

(6) *The Lumbar Veins* (four on each side).

The left spermatic vein usually joins the left renal vein. The branches of the aorta, from above downwards, are:—

(1) *The Inferior Phrenic*, which on the right side passes upwards and to the right, behind the inferior vena cava; on the left side upwards and to the left, behind the œsophagus. On each side the inferior phrenic furnishes a branch to the suprarenal capsule.

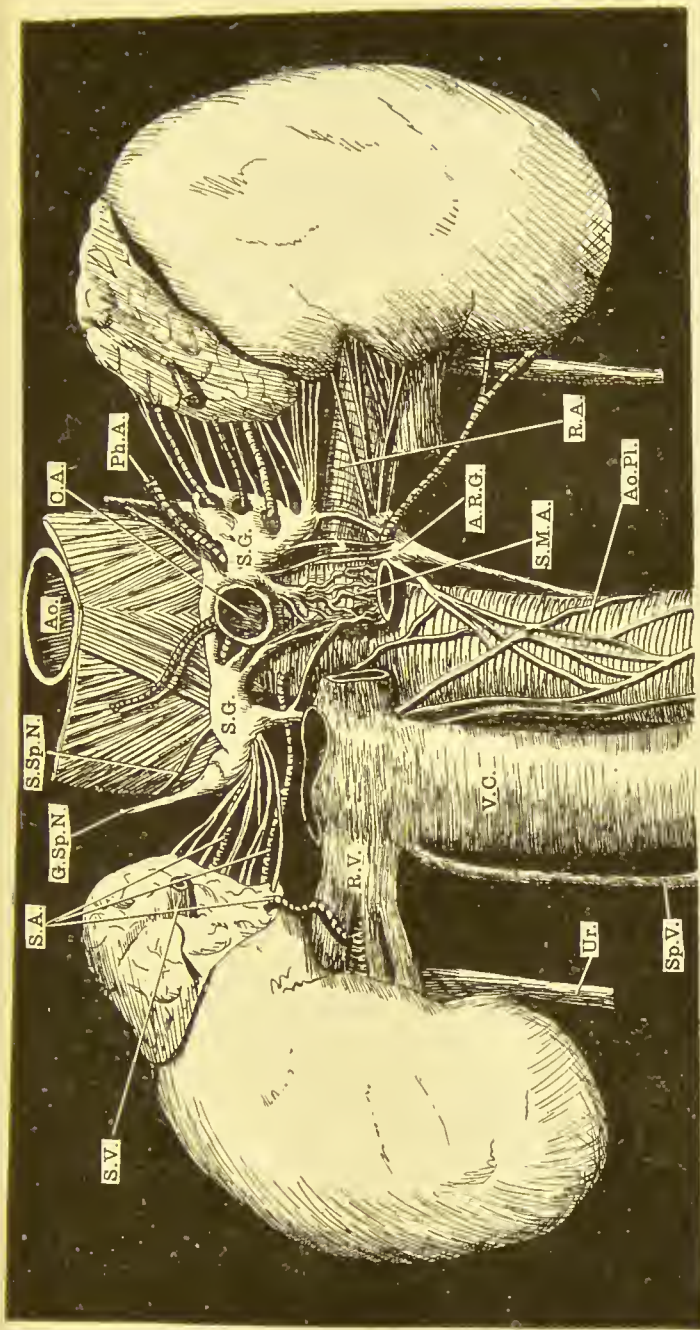


FIG. 261.—THE SOLAR PLEXUS, SUPRARENALS, AND KIDNEYS. (TRACED WITH THE DIAGRAPH FROM A SPECIMEN IN ST. THOMAS'S HOSPITAL.)

Ao. Aorta. *C.A.* Coeliac Axis. *G.Sp.N.* Great Splanchnic Nerve. *S.Sp.N.* Small Splanchnic Nerve. *Ph.A.* Phrenic Artery. *S.A.* Suprarenal Arteries. *S.V.* Suprarenal Vein. *S.G.* Semilunar Ganglion. *A.R.G.* Aortic-renal Ganglion. *R.A.* Renal Artery. *R.V.* Renal Vein. *S.M.A.* Superior Mesenteric Artery and Plexus. *Ao.Pl.* Aortic Plexus. *V.C.* Inferior Vena Cava. *Sp.V.* Spermatic Vein. *U.* Ureter.

(2) *The Cœliac Axis*, already studied (see p. 163).

(3) *The Superior Mesenteric*, which rises just below the last, and has a considerable course behind the head of the pancreas before it passes through the notch in that viscus.

(4) *The Middle Capsular* [a. suprarenalis media], on each side.

(5) *The Renal*, on each side, which gives off the inferior capsular [a. suprarenalis inferior].

(6) *The Spermatic* [a. testicularis] or *Ovarian* [a. ovarica], on each side.

(7) *The Inferior Mesenteric*, coming off from the front of the aorta about $1\frac{1}{2}$ inch above its bifurcation.

(8) *The Lumbar Arteries*, four on each side, rising from the back of the aorta.

(9) *The Middle Sacral*, also rising from the back of the aorta about half an inch above its bifurcation.

Of these Nos. 1, 8, and 9 are parietal arteries, while the others are visceral.

In exposing the beginnings of these arteries the solar plexus should not be forgotten. It will be found to send prolongations upwards and downwards along the aorta as well as along all its branches to the various viscera of the abdomen. In this way there are *aortic*, *diaphragmatic*, *capsular*, *renal*, *superior mesenteric*, *spermatic* and *inferior mesenteric plexuses*. Along the branches of the cœliac axis there are *coronary*, *hepatic* and *splenic plexuses*, while the *aortic plexus* is continued downwards over the bifurcation to form a large plexus—the *hypogastric*—in front of the body of the fifth lumbar vertebra. The solar plexus is not entirely sympathetic, seeing that it receives a few twigs from the vagus of either side.

In the dissection just described a number of lymphatic nodes are usually encountered; they lie at the side of the aorta—*juxta-aortic group*—in front of the aorta—*pre-aortic*—and behind the aorta—*retro-aortic*. Among these aortic nodes, and especially near the renal and splenic arteries, look

for some of a brighter red colour than the rest. These are the *hæmolymph nodes*, apparently transitional structures between the spleen and ordinary lymphatic nodes.

The anterior aspect of the kidneys and suprarenal bodies should be examined next.

Notice that the *right suprarenal* body is triangular, while the *left* is crescentic; that the right is in contact with the liver, except near its inner (medial) margin, where it lies behind the inferior vena cava; that the left is in contact with the stomach above and with the pancreas below (see Fig. 261).

Each capsule will be seen to be partly covered by peritoneum anteriorly; thus, on the right side, there is peritoneum covering the lower part of the hepatic area, but none in front of the upper part or of the caval strip. On the left side there is peritoneum of the lesser sac between the suprarenal and the stomach, but none between the gland and the pancreas.

Each suprarenal has a slit-like hilum on its anterior surface through which the capsular vein comes out. The arteries enter at various points.

The anterior surface of the *right kidney* is in relation to the liver above, to the hepatic flexure of the colon below, and to the second part of the duodenum near the hilum. Its lower pole was seen to be crossed by the ascending branch of the right colic artery. With the exception of its inner and lower part, it is covered by peritoneum (see Fig. 262).

The *left kidney* has in front of it the stomach above, the spleen externally, the pancreas transversely across from the hilum to the splenic area, the splenic flexure of the colon below that, while the lower pole is in contact with coils of jejunum and is crossed by the ascending branch of the left colic artery.

Now divide the aorta just below the diaphragm (taking care not to injure the receptaculum chyli, which lies behind and to the right of it) and again just above the origin of the

spermatic artery. At the same lower level tie and divide the inferior vena cava (it has been divided already above). Find the ureter on each side, running down in front of the psoas muscle, and divide it just below the renal vessels.

The isolated portions of these large vessels, with the suprarenal capsules, kidneys, solar plexus and lymphatic nodes, may now be removed by turning the viscera on either side forwards to the middle line in the manner already adopted for removing the duodenum and pancreas. The posterior aspect of this

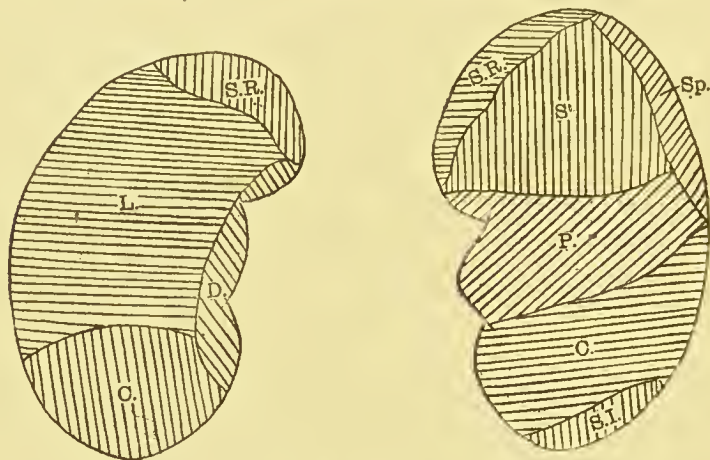


FIG 262 — DIAGRAM OF THE KIDNEYS FROM IN FRONT TO SHOW THEIR RELATIONS.

S.R. Suprarenal Area. *L.* Liver. *D.* Duodenum. *C.* Colon. *St.* Stomach. *Sp* Spleen. *P.* Pancreas. *S.I.* Small Intestine.

specimen can now be cleaned, after which it may be put aside to be replaced *in situ* from time to time in order to facilitate the appreciation of the relations of parts. By the removal of the parts just mentioned, the posterior abdominal wall is exposed, and should be most carefully and systematically studied.

POSTERIOR ABDOMINAL WALL

Begin, therefore, by defining the bodies of the vertebræ covered by the vertical fibres of the anterior common ligament.

Pressure by the finger at the sides of the bodies will disclose the situation of the transverse processes of the five lumbar vertebrae. Above the transverse process of the first lumbar vertebra

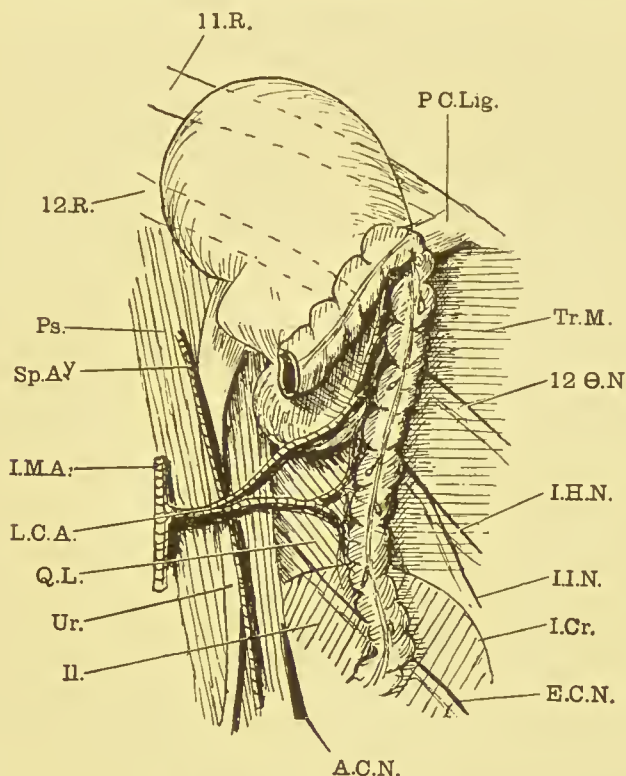


FIG. 263. — DIAGRAM OF THE RELATIONS OF THE LEFT HALF OF THE POSTERIOR ABDOMINAL WALL

11 R. Eleventh Rib. 12 R. Twelfth Rib. Ps. Psoas. Sp.Ar. Spermatic Artery. I.M.A. Inferior Mesenteric Artery. L.C.A. Left Colic Artery. Q.L. Quadratus Lumborum. Ur. Ureter. Il. Iliacus. A.C.N. Anterior Crural Nerve. E.C.N. External Cutaneous Nerve. I.Cr. Iliac Crest. I.I.N. Ilio-inguinal Nerve. I.H.N. Ilio-hypogastric Nerve. 12 Θ.N. Twelfth Thoracic Nerve. Tr.M. Transversalis Muscle. P.C.L. Phrenico-colic Ligament.

the last rib can be easily felt, while on the level of that of the fifth the iliac crest is readily found. The internal and external arcuate ligaments [arcus lumbo-costalis medialis et lateralis] should be now defined; they have a common attachment to

the transverse process of the 1st lumbar vertebra. From this bony point the internal arches inwards to the body of the second lumbar vertebra, while the external arches outwards to the last rib. From the upward convexity of these arches the diaphragm will be seen to arise, while along their concavity they are continuous with fasciæ of considerable strength, the sheath of the psoas and the anterior lamella of the lumbar aponeurosis in front of the quadratus lumborum, which descend over the posterior abdominal wall, separating the muscles behind from the extra-peritoneal tissue in front.

In defining the sheath of the psoas some very important structures will be met with. In the first place the peritoneum must be dissected away, and immediately behind this the right and left colic vessels will be found on their respective sides; if the latter are followed inwards (medially) the inferior mesenteric vessels will be exposed.

Deep to the colic vessels the *spermatic* or *ovarian vessels* are seen. If the subject is a male, the spermatic vessels should be traced down to the internal abdominal ring, the situation of which has been defined already (see p. 85).

In the female the ovarian artery has a course nearer the mid line of the abdomen, and makes for the point of bifurcation of the common iliac artery, and descends in the ovario-pelvic ligament to be noticed later.

On a deeper (posterior) plane is the *abdominal course of the ureter*, which runs nearly vertically downwards from the hilum of the kidney to the bifurcation of the common iliac artery, and is four to five inches in length. As the iliac vessels have not yet been studied, it should be noticed that the bifurcation of the common iliac artery will be found by drawing a line from the bifurcation of the aorta to a point midway between the anterior superior iliac spine and the symphysis pubis; at the junction of the upper and middle thirds of this line the bifurcation of the common iliac artery

and the end of the abdominal part of the ureter will be felt through the peritoneum.

On the side which has not yet been dissected it is well to

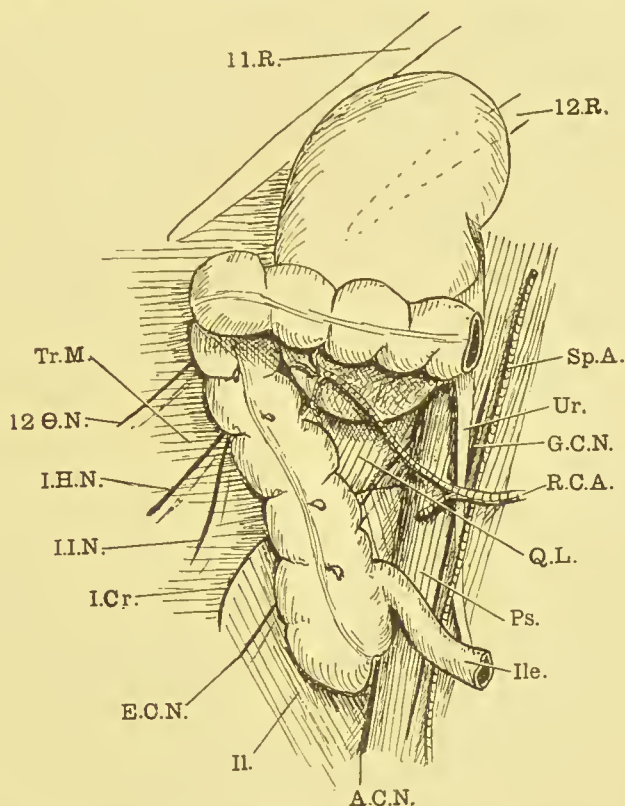


FIG. 264.—DIAGRAM OF THE RELATIONS OF THE RIGHT HALF OF THE POSTERIOR ABDOMINAL WALL.

11 *R.*, 12 *R.* Corresponding Ribs. *Tr.M.* Transversalis Muscle. 12 Θ .*N.* 12th Thoracic Nerve. *I.H.N.* Ilio-hypogastric Nerve. *I.I.N.* Ilio-inguinal Nerve. *I.Cr.* Iliac Crest. *E.C.N.* External Cutaneous Nerve. *Il.* Iliacus. *Sp.A.* Spermatic Artery. *Ur.* Ureter. *G.C.N.* Genito-crural Nerve. *R.C.A.* Right Colic Artery. *Q.L.* Quadratus Lumborum. *Ps.* Psoas. *Ile.* Ileum. *A.C.N.* Anterior Crural Nerve.

make an exploratory incision through the peritoneum in order to pick up the ureter. Notice, too, that, although the ureter is crossed anteriorly both by the colic and spermatic vessels, it is closely adherent to the peritoneum, and in retro-

peritoneal operations always moves with the peritoneum when the latter is turned aside. As it enters the pelvis, it will be understood, if the lines of the small and large intestines be reconstructed, that it passes behind the ileum on the right side and the pelvic colon on the left. On both sides the ureter in the abdominal portion of its course has overlying it coils of small intestine. It should also be observed how close the ureter on the right side lies to the inferior vena cava. Traced inwards, the fascia over the psoas forms a series of fibrous arches opposite the concave lateral surfaces of the bodies of the vertebræ, thereby forming osseo-fibrous foramina, through which pass the lumbar vessels and small nerve connections between the anterior primary divisions of the spinal nerves and the lumbar sympathetic ganglia. Traced outwards, the fascia blends immediately beyond the outer border of the psoas with the fascia over the quadratus lumborum. Below, the fascia throws a wing-like expansion outwards to enclose the iliacus muscle and to gain an attachment to the iliac crest. It then passes down, covering the ilio-psoas, which it follows under Poupart's ligament to its insertion. Internally, in its lower part, it is attached along the ilio-psoas line. The fascia in front of the quadratus lumborum has been noticed already on one side in the dissection to expose the lower pole of the kidney from behind; it is the anterior lamella of the lumbar aponeurosis, and passes inward behind the psoas, outwards to fuse with the rest of the lumbar fascia, downwards to the iliac crest. These two fasciæ, particularly the fascia in front of the psoas, are of great importance in surgery. A knowledge of the attachments of the fascia which covers the psoas explains why, if suppuration enters the so-called sheath of the psoas, it tracks downwards into the thigh. The fasciæ are not to be regarded as everywhere complete, for they are perforated by blood vessels, and more particularly by nerves. These nerves should now be found. Close to the inner border of the psoas and its sheath lies the *lumbar sympathetic cord*, which should be traced upwards to

where it enters the abdomen behind the inner extremity of the internal arcuate ligament and downwards to where it passes behind the common iliac artery into the pelvis. Upon the cord are developed four or five ganglia, from which pass, as already mentioned, fine communicating branches to the anterior primary divisions of the spinal nerves. It passes through the sheath of the psoas at its upper and inner angle.

The last thoracic nerve with the accompanying subcostal vessels will be found piercing the fascia over the quadratus lumborum just below the last rib, having entered the abdomen behind the external arcuate ligament (see Fig. 263, 12 Θ).

At the outer border of the psoas, and an inch or so below the last thoracic (subcostal) nerve, two nerves may be found crossing the quadratus lumborum muscle obliquely in a downward and outward direction. These are the *ilio-hypogastric* and *ilio-inguinal* branches of the 1st lumbar nerve (see Fig. 263, I.H.N., I.I.N.). It is not uncommon for these nerves to make their appearance from under cover of the outer border of the psoas as a single trunk which divides later. The nerves pierce the fascia covering the psoas at the outer border of the muscle, pass outwards in front of the quadratus lumborum and its fascia, and pierce the transversalis muscle an inch or two beyond the outer border of the quadratus lumborum to gain the interval between the transversalis and internal oblique muscles. Running nearly parallel to the two nerves mentioned above, but rather more obliquely downwards, is the *external cutaneous nerve* [n. cutaneus femoris lateralis] (see Fig. 263, E.C.N.). It leaves the outer border of the psoas a little above the level of the iliac crest, crosses the iliacus muscle and passes into the thigh under Poupart's ligament, close to the anterior superior iliac spine. Lying close to the outer border of the psoas, in its lower part will be found the large anterior crural nerve [n. femoralis] (see Fig. 263, A.C.N.), while opposite to it, on the inner side of the psoas, is the *obturator nerve* (see Fig.

265, Ob.N.), and behind and internal to this the larger *lumbo-*

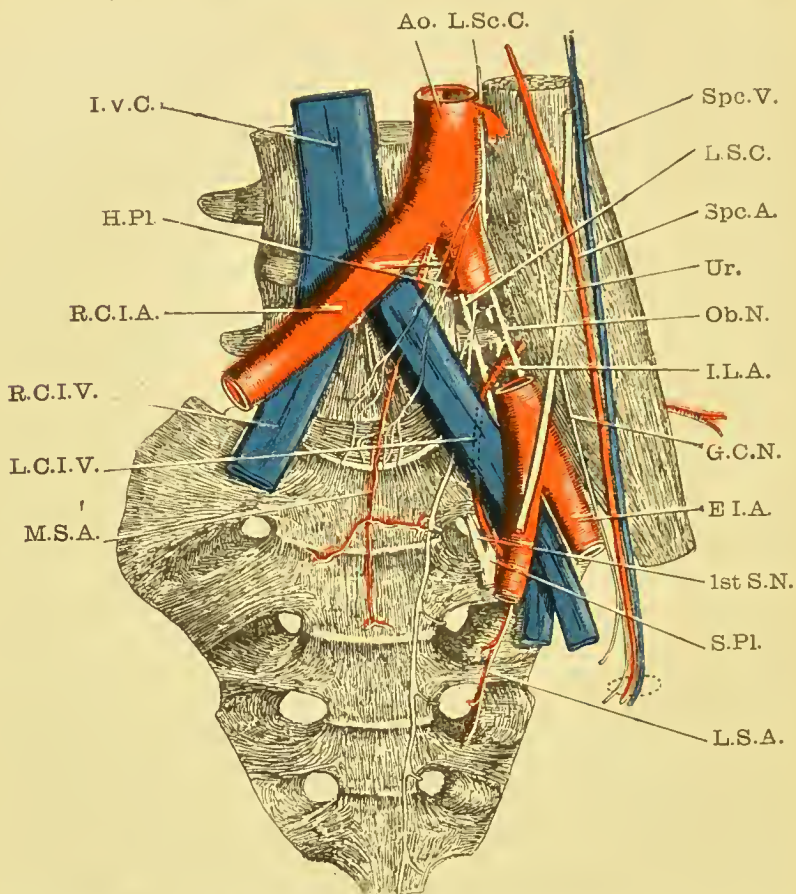


FIG 265.—VIEW OF SOME OF THE RELATIONS OF THE LEFT PSOAS MUSCLE.

Ao. Aorta. *I.V.C.* Inferior Vena Cava. *H.Pl.* Nerves to Hypogastric Plexus. *R.C.I.A.* Right Common Iliac Artery. *R.C.I.V.* Right Common Iliac Vein. *L.C.I.V.* Left Common Iliac Vein. *M.S.A.* Middle Sacral Artery. *L.Sc.C.* Left Sympathetic Cord. *Spc.V.* Spermatic Vein. *Spc.A.* Spermatic Artery. *L.S.C.* Lumbo-sacral Cord. *Ur.* Ureter. *Ob.N.* Obturator Nerve. *I.L.A.* Ilio-lumbar Artery. *G.C.N.* Genito-crural Nerve. *E.I.A.* External Iliac Artery. *1st S.N.* First Sacral Nerve. *S.Pl.* Upper Part of Sacral Plexus. *L.S.A.* Lateral Sacral Artery.

sacral cord [truncus lumbo-sacralis] (see Fig. 265, L.S.C.). In order to find these two nerves, the dissector must draw

apart the psoas and the common iliac artery. A large branch from the anterior crural nerve to the iliacus muscle should be sought in the iliac fossa. A small nerve can sometimes be found descending along the inner border of the psoas superficial to the obturator nerve; it is the *accessory obturator*, and is readily distinguished below by passing over the upper ramus of the pubis, whereas the obturator itself passes under the ramus. One nerve more should be found, the *genito-crural* [n. genito-femoralis]; it appears on the anterior surface of the psoas, and descends vertically, lying between the psoas and its sheath, until it divides into its genital and crural branches, the former entering the internal abdominal ring, the latter lying in close relation to the outer side of the femoral artery. The genito-crural is readily told by its being the only nerve which makes its appearance on the anterior surface of the psoas (see Fig. 265, G.C.N.).

With the last thoracic nerve will be found the subcostal vessels, while crossing the quadratus lumborum transversely, immediately above the iliac crest, are the last lumbar vessels. Finally, on the iliacus muscle certain branches of the ilio-lumbar vessels are frequently seen anastomosing with branches of the deep circumflex iliac vessels.

These vessels and nerves should be traced in an upward and downward direction. Next clean the psoas and quadratus lumborum muscles, and, in doing so, it will be noticed that the fascia which covers them is of a cellular texture and is different only in its greater density from the fascia which covers all muscles except above, where it thickens to form the internal and external arcuate ligaments, from which the diaphragm arises, and below where it binds down the iliacus and psoas muscles to the margins of the iliac fossa, and where, in front of the origin of the quadratus lumborum muscle, it is thickened to form the ilio-lumbar ligament.

The crura of the diaphragm should now be carefully cleaned, the splanchnic nerves which pierce them and have been necessarily divided in the removal of the solar plexus

should, if possible, be found, cleaned, and preserved. The left ascending lumbar vein should also be sought in cleaning the left crus, which it pierces on its way to the thorax.

The upper portion of the inferior vena cava lies in front of the right crus, the forward and upward curve of which it follows to its aperture in the tendinous portion of the diaphragm. As most of the inferior vena cava has, however been removed (1) with the liver and (2) with the kidneys, the course of the upper portion of this large vein can only be demonstrated by replacing these viscera. This can be done now as well as at a later stage.

Between the crura and to the right of the aorta lies the *right ascending lumbar vein*, a longitudinal trunk linking together the transversely coursing lumbar veins, which pass inwards from under cover of the fibrous arches of the psoas to open into the inferior vena cava. This ascending lumbar vein is the beginning of the vena azygos major, but the latter vessel always has a communication with the back of the vena cava as well. In many cases the ascending lumbar vein is hardly visible, and then the vena azygos rises entirely from the inferior vena cava.

In the interval between the aorta and right ascending lumbar vein, but on a more posterior plane, opposite the twelfth thoracic, or first lumbar vertebra, the receptaculum chyli [cisterna chyli], or beginning of the thoracic duct, should be looked for. It is sometimes quite a definite dilatation, but very often nothing more is to be found than a number of swollen radicles uniting to form a common duct, and closely resembling a dahlia root.

Of these radicles one comes from the mesentery, one each side ascending from the aortic nodes, and one each side descending from the lower part of the thoracic wall.

The above-mentioned structures having been traced as far as possible in an upward and downward direction, the student should now turn his attention to the *Diaphragm*. Begin by tracing the right crus upwards, and note how its fibres sepa-

rate to surround the œsophagus; the fibres of the left crus take, as a rule, no part in the bounding of the œsophageal aperture. From the right crus to the right of the œsophagus a band of muscular tissue should be looked for; it passes downwards close to the cœliac axis, sometimes dividing to enclose this artery, to reach the root of the mesentery, into which it passes; it is called the *suspensory ligament of the duodenum*. It was of necessity cut in removing the duodenum and jejunum. The portions of the diaphragm which arise from the internal and external arcuate ligaments, from the internal surfaces of the lower six costal arches, interdigitating with the transversalis muscle, and from the posterior surface of the ensiform cartilage should all be carefully cleaned by removing peritoneum and areolar tissue. It will then be seen that from all these origins muscular fibres converge to be inserted into the large central tendon, which is crescentic and somewhat trefoil, the lobes being right, anterior, and left, in the order of their size. In the right lobe the orifice of the inferior vena cava has been seen already. It is sometimes possible to pick up on the walls of the inferior vena cava, just as it is leaving the abdomen, a few fine nerve filaments—branches from the right phrenic nerve.

In cleaning the left dome of the diaphragm the stomach will be doubtless in the way, but it is better for the present to keep it attached to the œsophagus, turning it from side to side when necessary.

POSTERIOR RELATIONS OF KIDNEYS

It will now be instructive to replace the three specimens removed and cleaned, in order that the relations of the various organs may be revised. Begin by placing the specimen of suprarenals, kidneys, inferior vena cava, and aorta in its original position, and note the following cardinal features: that each *kidney* lies in front of the crus, psoas, quadratus lumborum, and transversalis muscles, the last thoracic, ilio-hypogastric, and ilio-inguinal nerves, and the

subcostal vessels; that the suprarenal capsules have only the diaphragm behind them.

The *Inferior Vena Cava* lies in front of the right crus and right suprarenal capsule, the right inferior phrenic artery, and the right semilunar and aortico-renal ganglia, which latter lie partly anterior to the right renal artery. The *Right Renal Vessels* lie in front of the sympathetic cord, while the right ureter descends immediately to the outer side of it. The inferior vena cava lies throughout to the medial side of the right psoas and right sympathetic cord.

Now take the specimen of duodenum, pancreas, and spleen and place it in position, noting that the duodenum lies in front of the right suprarenal, right kidney, renal vessels, ureter, sympathetic cord, inferior vena cava, common bile duct, portal vein, gastro-duodenal artery, aorta, left sympathetic cord, and left psoas.

The *Pancreas* crosses in front of the inferior vena cava, ascending lumbar veins, receptaculum chyli, aorta, left crus, left sympathetic cord, left psoas, left kidney and suprarenal, left renal vessels, and semilunar ganglion. The portal vein and its tributaries are also posterior relations, but have been noticed already.

THE STOMACH CHAMBER

Notice the cavity in which the stomach lies; it is known as the *stomach chamber*, and is pyramidal or pyriform in shape, the apex of the pyramid lying on the right side and the base on the left.

Replace the liver, and notice how it and the diaphragm form the roof of the stomach chamber.

Lift up the stomach, and notice how the pancreas, spleen, left kidney, left suprarenal, and diaphragm form the posterior wall.

The base or left wall is made by the spleen and diaphragm.

The floor has been removed now, but originally consisted of the transverse colon and meso-colon.

The anterior wall has been studied already (see p. 132); it

is formed by the liver, diaphragm, and sheaths of the rectus abdominis muscles, while the apex is the point at which the hepatic flexure of the colon touches the liver.

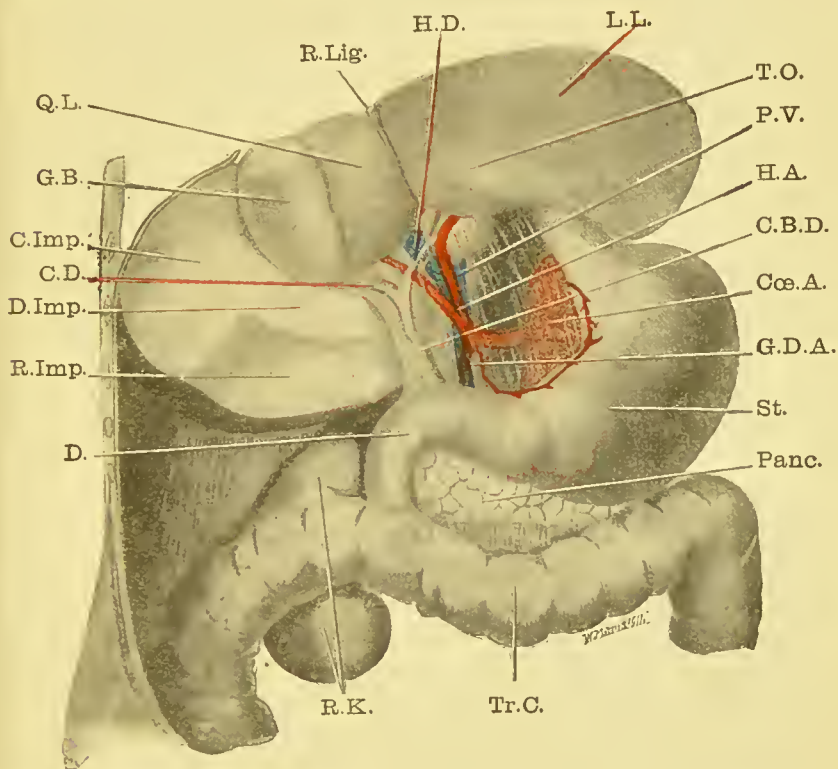


FIG. 266.—RELATIONS OF THE STOMACH TO SURROUNDING VISCERA.

D. Duodenum. *R.Imp.* Renal Impression on the Liver. *D.Imp.* Duodenal Impression on the Liver. *C.Imp.* Colic Impression on the Liver. *C.D.* Cystic Duct. *G.B.* Gall Bladder. *Q.L.* Quadrate Lobe. *R.Lig.* Round Ligament. *H.D.* Hepatic Duct. *L.L.* Left Lobe. *T.O.* Tuber Omentale. *P.V.* Portal Vein. *H.A.* Hepatic Artery. *C.B.D.* Common Bile Duct. *Cœ.A.* Coeliac Axis. *G.D.A.* Gastro-duodenal Artery. *St.* Stomach. *Panc.* Pancreas. *Tr.C.* Transverse Colon. *R.K.* Right Kidney.

It will be understood now that the *stomach bed*, a term already used once or twice, is the same thing as the back, floor, and left wall or base of the stomach chamber.

If the liver be again removed, it will be seen that while

its inferior surface lies against the right kidney, duodenum, and stomach, its posterior surface is in contact with the right dome of the diaphragm, right suprarenal capsule, inferior vena cava, middle part of diaphragm, œsophagus, and left dome.

The viscera, including the stomach, should now be removed and examined more carefully, in order to see as much of their structure as can be done with the naked eye.

STRUCTURE OF THE STOMACH.—Inflate the organ as fully as possible with the bellows, ligaturing the œsophagus and duodenum close to the cardiac and pyloric orifices. Dissect off the peritoneum, noticing the delicate *subserous cellular tissue*. The muscular fibres of the stomach are arranged in three layers:—

(1) The most superficial are longitudinal and are best marked along the two curvatures, especially the lesser. As the pyloric canal is reached, they are more evenly arranged, so as to continue the uniform layer of the duodenum.

(2) The circular layer of fibres is evenly disposed and is thickened at the pylorus, forming the constriction of that orifice.

(3) The oblique fibres are best marked at the cardiac end, and may be described as astride of the fundus to the left of the cardiac orifice; from this they radiate on the front and back of the stomach, disappearing as the great curvature and pyloric canal is approached.

The *submucous coat* is well marked, and in it the blood vessels break up.

The *mucous membrane* may be displayed by laying open the whole stomach along its greater curvature. In a fresh stomach this layer has a pink colour, though in old people dark grey patches are often present. When the organ is undistended, the membrane is thrown into very prominent folds or *rugæ*, which disappear on distension.

STRUCTURE OF THE LIVER.—Look at the upper part of the slit-open vena cava, where it is embedded in the liver, and notice the entrance into it of the right, middle, and left

hepatic veins. Make a few sections through the liver substance across these veins, thus tracing them farther and farther away from the vena cava as they become smaller and more numerous.

Find the portal vein once more in the transverse fissure.

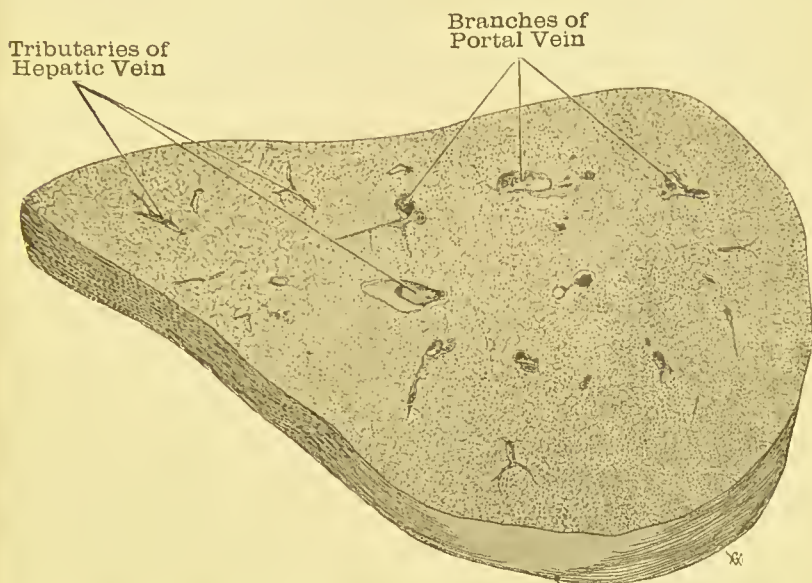


FIG. 267.—SECTION OF THE LIVER TO SHOW ITS NAKED-EYE STRUCTURE.

and make a series of tangential sections through the liver so as to cut these vessels across.

Now make one great vertical incision through the middle of the liver, and compare the cut vessels with those of the two former series. It is usually said that the hepatic vein's tributaries may be distinguished fairly easily from the branches of the portal vein, because the former are very thin-walled and are so closely adherent to the liver substance that they do not collapse. In our experience all the vessels are usually open, but the branches of the portal vein may be readily known, because they are accompanied by branches of the hepatic artery (see Fig. 267).

STRUCTURE OF THE SUPRARENAL GLANDS

Before making a section of these glands, notice what an enormous number of nerves enter them from the solar plexus. Their connection with the sympathetic system therefore is obviously a very close one. Now cut right through the gland when a yellowish cortical layer and a darker medullary portion of a reddish-brown colour will be seen.

STRUCTURE OF THE KIDNEYS

Split one kidney vertically, so as to separate the anterior half from the posterior, and open up the *hilum*. Trace the renal vessels and the pelvis or upper dilated part of the ureter into this opening, after which they will be seen to lie in a cave-like space padded up with fat and known as the *sinus renalis*. Here most of the blood vessels lie in front of the pelvis, but one branch of the artery passes behind the pelvis and also above it. As long as there is an appreciable amount of pelvis and ureter left, it is quite easy to tell the side of an excised kidney, because the ureter is behind the vessels, except for the branch just mentioned, and will only hang down comfortably when the top of the kidney is uppermost.

When, however, the structures are cut quite close to the hilum the direction of the ureter cannot be known, and the presence of the posterior branch of the artery above and behind the pelvis is usually quite enough to ensure the kidney being placed in its right position (see Fig. 268).

Now slit open the ureter and pelvis, and notice whether the latter divides into upper and lower parts, as is often the case. These two parts are known as the *infundibula* [calyces majores], and they are important to notice because the division moderately often extends right down to the bladder, causing *double ureter*. It is very rare, however, for the ureter to continue double into the bladder.

Each infundibulum, as it approaches the kidney sub-

stance, ends in a series of cup-shaped apertures, the *calyces* [e. minores], which are usually either eight or ten in number, and are arranged as the pips are in the eight or ten of a playing eard; that is to say, if there are eight altogether, three will be in front, three behind, one above and one below.

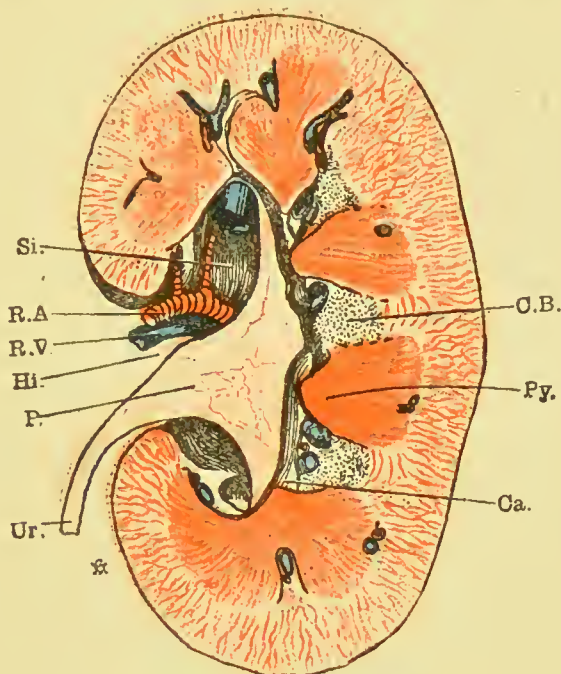


FIG 268.—SECTION OF A KIDNEY.

Si. Sinus. *R.A.* Renal Artery. *R.V.* Renal Vein. *Hi.* Hilum. *P.* Pelvis
Ur. Ureter. *C.B.* Column of Bertin. *Py* Pyramid. *Ca.* Calyx.

Into these calyces the apices of the *pyramids of Malpighi* [pyramides renales] fit, though sometimes two pyramids are received into one calyx; there are therefore some twelve to fifteen pyramids in each kidney. In a fresh kidney the pyramids are dark red, and their bases are separated from the surface of the kidney by the *cortex*, which is lighter in colour and projects between some of the pyramids as the *columns of Bertin* [columnæ renales]. There is also to be seen in the cortex a series of faint radiating rays known as *pyramids of*

Ferrein [pars radiata], formed by collections of kidney tubules. The central part of the kidney is known as the medulla.

When the kidney is congested or minutely injected, very small red dots may be noticed in the cortex—the vascular *glomeruli*.

Finally, the tough *capsule of the kidney* should be peeled off with the finger and thumb; in a healthy organ it should come away quite easily.

Experience teaches us that it will not be a waste of space to impress on the dissector the distinction between the terms sinus, hilum, and pelvis, since they are so often confused or misunderstood.

(1) The *pelvis* is the upper dilated part of the ureter.

(2) The *sinus* is the cave in the interior of the kidney containing the pelvis and the renal vessels.

(3) The *hilum* is the opening into the sinus.

THE LOWER ABDOMINAL VESSELS AND NERVES

The branches of the abdominal aorta and the tributaries of the inferior vena cava which have not been fully traced yet are, on each side, four lumbar arteries and veins, the veins lying posterior to the arteries; the inferior mesenteric artery on the left side, which enters the pelvis by crossing the left common iliac vessels, and the middle sacral, which arises from the posterior aspect of the aorta a little, but still an appreciable distance, above its termination and runs down in the mid line of the sacrum.

The inferior mesenteric artery is accompanied by a well-marked sympathetic plexus, in which a ganglion (the inferior mesenteric) is usually easily found. It gives off the left colic (Fig. 263), sigmoid, and superior hæmorrhoidal branches.

The *Hypogastric Plexus* should now be exposed. It is a large sympathetic plexus situated in the angle formed by the bifurcation of the abdominal aorta, and lies in front of the body of the 5th lumbar vertebra. It is formed by filaments on the aorta as well as by hypogastric filaments from the

lumbar sympathetic cord which cross the common iliac

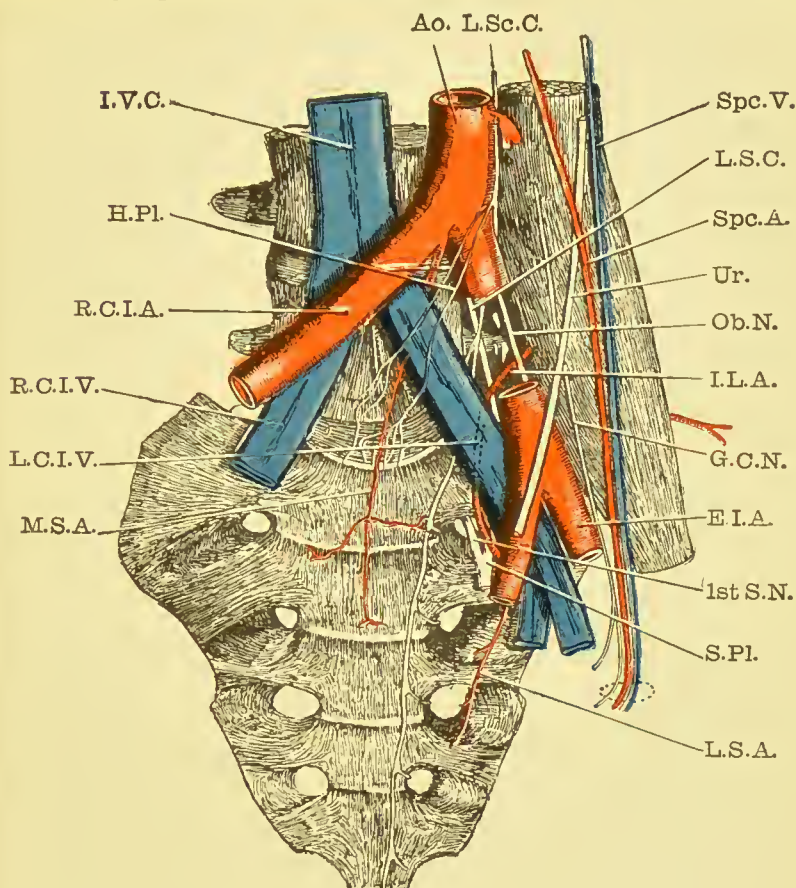


FIG. 269.—BLOOD VESSELS OF PELVIS.

Ao. Aorta. *I.V.C.* Inferior Vena Cava. *H.Pl.* Nerves to Hypogastric Plexus. *R.C.I.A.* Right Common Iliac Artery. *R.C.I.V.* Right Common Iliac Vein. *L.C.I.V.* Left Common Iliac Vein. *M.S.A.* Middle Sacral Artery. *L.Sc.C.* Left Sympathetic Cord. *Spc.V.* Spermatic Vein. *Spc.A.* Spermatic Artery. *L.S.C.* Lumbo-sacral Cord. *Ur.* Ureter. *Ob.N.* Obturator Nerve. *I.L.A.* Ilio-lumbar Artery. *G.C.N.* Genito-crural Nerve. *E.I.A.* External Iliac Artery. *1st S.N.* First Sacral Nerve. *S.Pl.* Upper Part of Sacral Plexus. *L.S.A.* Lateral Sacral Artery.

vessels. It divides into two plexuses (the pelvic plexuses) which accompany the internal iliac artery and its branches.

The student should now examine a small *Lumbo-Sacral Triangle*, bounded below by the ala of the sacrum, internally by the body of the 5th lumbar vertebra, and externally by the inner border of the psoas. Crossing the triangle will be found the common iliac vessels, while immediately posterior to them the lumbar sympathetic cord descends into the pelvis. Deep in the triangle and imbedded in a considerable amount of fat lie certain common iliac lymphatic nodes, the obturator nerve, the lumbo-sacral cord, and the ilio-lumbar vessels. The latter vessels will be found running upwards and outwards between the obturator nerve and lumbo-sacral cord (see Fig. 269).

THE MUSCLES OF THE POSTERIOR ABDOMINAL WALL

The *Psoas* [P. major] is a long pyriform muscle arising from the body of the last thoracic, the bodies and transverse processes of the five lumbar vertebræ and from the fibrous arches which bridge over the lumbar vessels. It can be seen at present passing down in front of the posterior part of the iliac crest, below which it is joined laterally by the iliacus.

In the majority of cases a small muscle with a long tendon, the *Psoas parvus* [P. minor], passes down in front of and close to the inner border of the psoas muscle. It arises from the adjacent portions of the bodies of the last thoracic and 1st lumbar vertebræ and the intervening disc. Below it blends with the fascia covering the psoas, accounting for the increased strength of the fascia there. It can in many cases be traced to an insertion into the ilio-pectineal eminence.

The *Quadratus Lumborum* is formed of two sets of fibres, some passing from the iliac crest to the transverse processes of certain lumbar vertebræ, others passing from the same or other lumbar transverse processes to the last rib. Its outer border is directed upwards and inwards, and almost coincides in position with the outer border of the erector spinæ muscle.

The *Iliacus* arises from the iliac fossa, the ala of the sacrum, and from the strong ligamentous fibres which bind the sacrum, ilium, and 5th lumbar vertebra together.

Transversalis Muscle.—To the outer side of the quadratus lumborum the fibres of the transversalis muscle will be seen passing outwards. This muscle has already been examined from the back. It may, however, be noted here that many of its fibres are directly continuous with those of the fascia in front of the quadratus lumborum, already referred to as the anterior lamella of the lumbar aponeurosis [fascia lumbodorsalis], which is attached to the front of the transverse processes of the lumbar vertebræ a little internal to their tips. The transversalis muscle is pierced an inch or two from the lateral border of the quadratus lumborum by the last thoracic, the ilio-hypogastric and ilio-inguinal nerves.

LUMBAR PLEXUS, ARTERIES, AND LIGAMENTS

The student should now trace on one side the various nerves which have been found already on the posterior abdominal wall to their origin from the lumbar plexus. In doing this the psoas muscle will be necessarily removed, while every care should be taken to preserve the rami communicantes between the sympathetic cord and the spinal nerves. The psoas must be cut away piecemeal as the various nerves are traced to the plexus. Begin by tracing the ilio-hypogastric and ilio-inguinal nerves inwards, when they will be seen to arise from the 1st lumbar nerve. The genito-crural nerve will be seen to come from the 1st and 2nd, the external cutaneous nerve from the 2nd and 3rd lumbar nerves. The anterior crural and the obturator both spring from the 2nd, 3rd, and 4th nerves, while the remaining portion of the 4th turns down to join the 5th nerve, and so forms the lumbosacral cord. The accessory obturator nerve when present may be traced to the 3rd and 4th lumbar nerves between the obturator nerve in front and the anterior crural behind. It

is not at all an unusual thing to find the branches of the lumbar as well as of the sacral plexus rising higher or lower than usual. In the former case the plexus is said to be "prefixed," in the latter "postfixed."

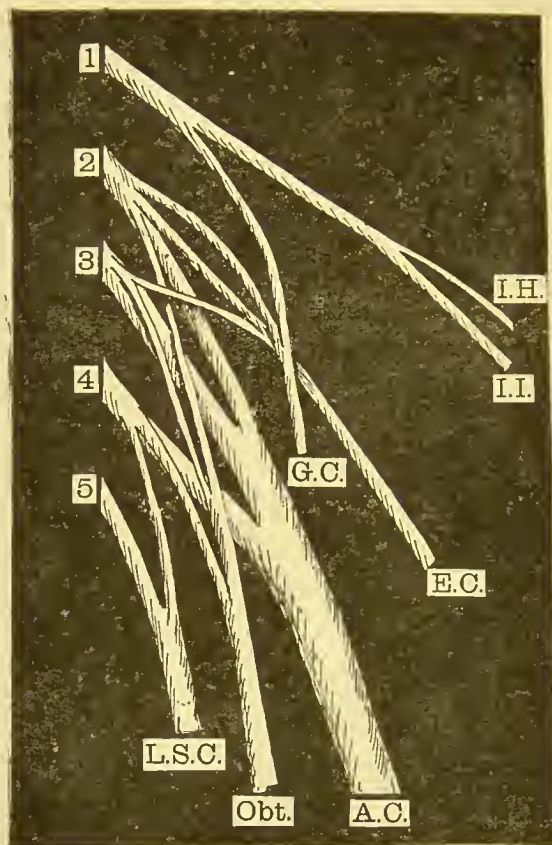


FIG. 270.—LUMBAR PLEXUS FROM IN FRONT.

1, 2, 3, 4, 5. Corresponding Lumbar Nerves. *I.H.* Ilio-hypogastric. *I.I.* Ilio-inguinal. *G.C.* Genito-crural. *E.C.* External Cutaneous. *A.C.* Anterior Crural. *Obt.* Obturator. *L.S.C.* Lumbo-sacral Cord.

The lumbar plexus now exposed is seen to be formed by the upper four lumbar nerves, with the addition in many cases of a descending filament from the last thoracic nerve. The plexus lies within the psoas muscle but close to its posterior surface.

The *Lumbar branches of the Abdominal Aorta* with their accompanying veins should next be followed from their origin, tracing them outwards behind the sympathetic cord and lumbar plexus. The upper two pass behind the crura of the diaphragm, the upper three run behind the quadratus lumborum muscle, the last, with remarkable constancy, running in front of the muscle. Near the outer border of this muscle the vessels pierce the lamellæ of the lumbar fascia and run forward between the transversalis and internal oblique muscles.

The dissection of the upper portion of the abdomen may now be considered as almost completed, and attention should next be directed to the lower portion. It will be convenient to separate the two portions by cutting through the intervertebral disc which lies between the fourth and fifth lumbar vertebræ, but before doing so the aorta should be divided just above its bifurcation and the vena cava at the same level, in order that the whole length of the common iliac vessels may be dissected with the pelvis. The vertebral column, so far as it is formed by the upper four lumbar vertebræ, should be stripped of its muscles in order that those ligaments which could not be exposed from the back may be seen. Running downwards in front of the bodies of the vertebræ as a broad ribbon-like band is the *Anterior Common Ligament*. The *Intertransverse Ligaments* which pass between the adjacent transverse processes should be exposed by removing the various muscles attached to these processes. The *Capsular Ligaments* attached to the articular processes around the articular facets should be similarly exposed. Finally, the *Intervertebral disc* must be examined; it will be seen to be tough and fibrous at the periphery, soft and pulpy in the centre, and to be formed by a series of concentric rings made of fibrous tissue and fibro-cartilage alternately. The soft central part is known as the *nucleus pulposus*.

THE PELVIS

Before beginning the dissection of the pelvis the student should revise what he has already learned in connection with the part. Turn the pelvis upside down and examine the perineum with the urethra, corpus spongiosum and anal canal or urethra, vagina and anal canal, according to sex, centrally; the ischio-rectal fossa and its various contents and relations laterally. Observe again how the levator ani muscle limits the ischio-rectal fossa above and internally; how it passes downwards and inwards from the lateral wall of the pelvis to be inserted into the middle line, its fibres surrounding the prostate anteriorly, the alimentary canal posteriorly. If it be possible, in the median line, re-identify the dorsal vein.

Now restore the pelvis to its normal position and examine it and its contents from above, so far as the latter can be seen at present through the overlying peritoneum. The *pelvic colon* and *rectum* can be readily recognised at the back, lying in front of the sacrum.

The PELVIC COLON should be examined very carefully, and the student will be well advised if he takes every opportunity of observing this structure in other bodies, for it varies greatly both in length and arrangement.

The iliac colon was traced as far as the inner margin of the left psoas (p. 130), and here the pelvic colon begins. It usually ends opposite the third piece of the sacrum, but between these two points it may take a straight course if it is very short or may form a loop like a U turned on its side,

C, with its convexity to the right. This variation in length is of practical importance, since, after excision of the rectum, it is sometimes possible to bring the pelvic colon down to the anus, while at other times this is impossible owing to the shortness of the gut. If the arterial supply of the pelvic colon is carefully traced it will be seen that the sigmoid branches of the inferior mesenteric artery which run to it anastomose quite freely with the branches of the left colic, but not at all freely with the superior hæmorrhoidal artery, which goes to the rectum and is the terminal branch of the inferior mesenteric artery (see Fig. 271).

Look for the bladder behind the symphysis. It can often be more readily recognised by grasping it between the fingers and thumb than by sight. Between the rectum and bladder will be seen in the female the antero-posteriorly flattened body of the uterus. Extending from the lateral margin of the uterus on either side to the wall of the pelvis a fold of peritoneum will be seen—the *broad ligament of the uterus* [L. *latum uteri*]. In the upper edge of this ligament the *Fallopian tube* [tuba uterina] can be felt passing to its *fimbriated extremity*, so called from a number of fringe-like processes which surround its orifice. Attached to the posterior surface of the broad ligament is the *ovary*. The fossa between the rectum and uterus is known as the *recto-uterine pouch* or *pouch of Douglas* [excavatio-recto-uterina], while that between the uterus and bladder is the *utero-vesical pouch* [excavatio-vesico-uterina].

In the male a large fossa lies between the rectum and bladder—the *recto-vesical pouch* [excavatio-recto-vesicalis]. Where the peritoneum passes from the floor of this fossa on to the posterior surface of the bladder a small structure may be felt on either side of the middle line. It is the upper end of the *vesicula seminalis*. Its exact position can be also determined by following the *vas deferens*, which is to be seen through the peritoneum, passing from

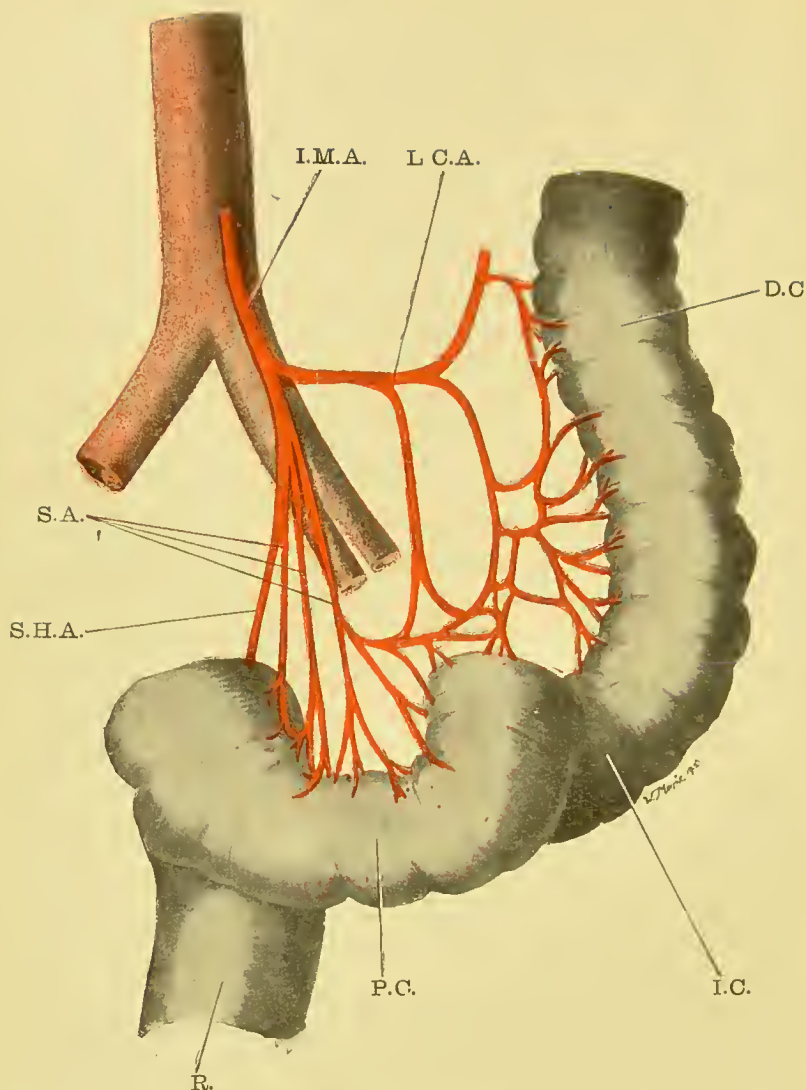


FIG. 271.—ARTERIAL SUPPLY OF THE DESCENDING, ILIAC, AND PELVIC COLONS.

I.M.A. Inferior Mesenteric Artery. *L.C.A.* Left Colic Artery. *S.A.* Sigmoid Arteries. *S.H.A.* Superior Hæmorrhoidal Artery. *D.C.* Descending Colon. *I.C.* Iliac Colon. *P.C.* Pelvic Colon. *R.* Rectum.

the brim of the pelvis backwards and then downwards and inwards, to lie finally immediately internal to the vesicula seminalis.

The lower part of the vasa deferentia and the vesiculae seminales raise the peritoneum of the floor of the rectovesical pouch into a transverse ridge known as the *recto-genital fold*, and so subdivide the pouch into an anterior and posterior compartment.

In the female a fold is seen running backwards and outwards from the neck of the uterus to the side of the sacrum; it is raised by the *utero-sacral ligament*, which contains some involuntary muscular fibres.

The *ureter* should next be followed by the eye and the finger without disturbing the peritoneum. On entering the pelvis it passes downwards and backwards, in front of and below the internal iliac artery, across the posterior part of the lateral wall to the ischial spine, on reaching which it turns inwards and forwards to the lateral angle of the bladder. In the female, after running behind the ovary, it passes round the neck of the uterus, while in the male it is crossed on its inner side by the vas deferens. Like the vas deferens, the ureter produces a peritoneal elevation of varying degrees of distinctness.

An attempt should now be made to examine the pelvis and its contents, as they may be examined in the living subject by a finger in the rectum or vagina, though it is necessary to warn the student that the presence of formalin in the body interferes a great deal with the possibility of this examination.

Remove the stitches around the anal orifice and, taking the pelvis to the sink, let a stream of water flow through the alimentary canal from the pelvic colon to the anus, thereby cleansing the passage.

Pass the index finger into the rectum, keeping it exactly in the middle line with its palmar surface posterior. By moving the finger up and down much of the anterior surface

of the sacrum, the whole anterior surface of the coccyx and the ano-coccygeal body can be examined. If the finger, while still in the rectum, be moved a little to the side of the middle line, certain of the lower sacral nerves can be recognised. On withdrawing the finger, turn the palmar surface to the side, and note how the anal canal can bulge into the ischio-rectal fossa, or how an accumulation of pus in the fossa can press upon the canal.

Now pass the finger along the canal with the palmar surface forward. In the female the posterior wall of the vagina, the cervix uteri and the body of the uterus can be felt; if necessary, pressure being made from above on the uterus. In the male $1\frac{1}{2}$ inch above the anus the apex of the prostate will be reached, $1\frac{1}{4}$ inch farther up, the base of the prostate. This is the method of examining the prostate in the living body, and the student should therefore make himself familiar with its position and nature. Immediately above the base of the prostate the bladder may be felt if the finger rigorously keeps to the middle line, while on either side of this portion of the bladder the vesiculæ seminales and vasa deferentia can be identified particularly if pressure be also applied from above.

In the female the *vagina* should be next explored. Pass the finger upwards, and identify first of all the cervix uteri. The interval between the cervix and the surrounding vaginal wall is divided into *anterior*, *posterior*, and *right* and *left lateral fornices*. If the student places one index finger in the anterior fornix and the other in the utero-vesical pouch, he will recognise that between the anterior vaginal wall and the peritoneal cavity a considerable amount of loose cellular tissue intervenes. If the fingers be now placed in the posterior fornix and the utero-rectal fossa, it will be found that no such cellular tissue there separates vaginal wall from peritoneum. Next explore the lateral fornices, in which it may be possible to feel the ureter as a round

cord and the ovary as an almond-shaped body. Pressure from above should again be applied.

On the anterior wall of the vagina in the middle line the urethra can sometimes be felt as a soft, rounded cord, leading upwards to the bladder and downwards to the external urinary meatus.

DISSECTION OF THE MALE PELVIS

These facts having been ascertained, the structures underlying the peritoneum should now be exposed. Make a median incision through the peritoneum from the gut behind to the symphysis pubis in front, and strip the peritoneum from the whole of the right side of the pelvis. The peritoneum above should be removed, and with care it may be reflected as a comparatively complete membrane, although it is firmly adherent to the gut behind and the bladder in front. The other half of the peritoneum should be left intact for purpose of reference.

The cellular tissue now exposed by the removal of the peritoneum should be carefully dissected away, while preserving all vessels and nerves. Begin by cleaning, so far as it is possible, the pelvic colon and rectum as low down as the levator ani. This portion is supplied by the *superior hæmorrhoidal artery*, the continuation of the inferior mesenteric artery into the pelvis, and by the middle hæmorrhoidal artery, a branch of the internal iliac. The nerves come from the sympathetic system and accompany the vessels.

Next take the *Vas Deferens*. In cleaning this tube the dissector need have little fear of injuring any other structure, since the vas lies on the peritoneal side of everything which it crosses. At the internal abdominal ring it will be found to loop over the deep epigastric artery; after which it runs almost directly backwards, towards the region of the spine of the ischium. In this course notice that it crosses internal to (1) the external iliac artery; (2) the external iliac vein,

(3) the obliterated hypogastric artery; (4) the obturator nerve, artery, and vein; and (5) the ureter. Near the ischial spine it makes a rather sharp turn downwards and inwards to the back of the bladder and to the inside of the vesicula seminalis. Close to its lower end it receives a small arterial twig from the superior vesical branch of the internal iliac artery.

The *vesicula seminalis* should next be cleaned, and then the bladder. In cleaning the latter begin by tracing the ureter down to its point of entry at the lateral angle. In removing the cellular tissue around the neck of the bladder, great care must be taken not to injure the prostate. In cleaning these various structures the pelvic floor, formed in front by the levator ani muscle and behind by the coccygeus muscle, will begin to be defined. It will also be noticed that the cellular tissue is not everywhere of the same consistence. It is more fibrous and membranous and less fatty in two regions:—

(1) On the inner side of the iliacus and obturator internus muscles, where it is known as the *fascia iliaca* or *parietal layer of the pelvic fascia*.

(2) On the upper surface of the levator ani muscle close to the pubis. Here it is connected quite firmly to the prostate, and is usually a really definite, silvery-looking, fibrous plane forming the *lateral and median pubo-prostatic ligament* [lig. pubo-prostaticum laterale et medium].

Many other refinements of the pelvic fascia are described, but they are of little practical importance and are difficult to verify.

So far only one half of the pelvis has been dissected, while the other has been left with the peritoneum *in situ*. This second half must now be dissected in the same way as the first. The process will be found much easier, since there is a more complete access to the part, and the student cannot fail to be helped by the knowledge which he has already gained. He should therefore pay particular

attention to the blood vessels, all of which should be carefully saved for future review (see p. 203).

By this procedure the viscera of the pelvis will be more or less isolated in the middle of the cavity, and their relations can be easily studied.

The portions of the alimentary canal within the pelvis are the pelvic colon, the rectum, and the anal canal. The *Pelvic Colon* has been studied already (p. 190); it is distinguished from the rectum by the possession of a meso-colon. Its posterior relations are the pelvic brim, the lower part of the sacro-iliac joint, the ala of the sacrum, the first three sacral vertebræ, the internal iliac vessels with their branches and tributaries, the obturator nerve, the lumbo-sacral cord and the upper two or three sacral nerves, the pyriformis muscle, and ureter—all of the left side. In immediate contact with the gut, posteriorly, are the superior hæmorrhoidal vessels. In the front of it lies the base of the bladder, when the latter viscus is distended. The pelvic colon is, as a rule, so disposed that a coil of it lies within the recto-vesical pouch in such a way that the upper portion of the coil is an anterior relation to the lower.

At the sides the pelvic colon is related to the cellular tissue of the pelvis enclosing the internal iliac vessels and the ureter, the parietal peritoneum, of course, intervening.

The RECTUM, beginning at the 3rd sacral vertebra, extends downwards in a sigmoid rather than in the straight manner implied by its name, to an inch in front of the tip of the coccyx, at which point it passes through the opening in the levator ani muscle and becomes continuous with the anal canal, which has been studied already in the perineum. There is seldom any meso-rectum, although the peritoneum does not at once leave the tube, but covers it anteriorly, and to some extent laterally, as low as the 5th sacral vertebra.

The relations of the rectum will be seen to be as follows:—

Posteriorly, the last two sacral vertebræ, coccyx, the

anterior common ligament, middle sacral and superior hæmorrhoidal vessels—the pyriformis above, the coccygeus and levator ani below—the lower sacral nerves and sacro-coccygeal plexus, the sympathetic cords, and the ganglion impar.

Anteriorly, the base of the bladder, vesiculæ seminales, vasa deferentia, prostate with coils of small intestine or of pelvic colon above.

Laterally, the internal iliac vessels, with their branches and tributaries, particularly the middle hæmorrhoidal vessels, also the ureter.

The **BLADDER** occupies the anterior part of the pelvis. In the dissecting-room subject it is usually of a pyriform shape, the apex in front, the base behind. The lower half of the pear lies in a bed of loose cellular tissue contained in the hammock or trough which the levatores ani muscles make.

The ureters enter the bladder wall at the lateral angles, where the sides join the base.

It is usual to describe an upper, a lower, two lateral surfaces; and a base or posterior surface.

Superiorly, the Bladder is covered by peritoneum, and is in relation to coils of small intestine and pelvic colon. Inferiorly, it lies on a bed of cellular tissue, which separates it from the levator ani muscle and symphysis pubis, and is often known as the "*cave of Retzius*." This is the anterior part of the inferior surface; more posteriorly it rests on the base of the prostate. When the viscus is distended its inferior surface comes successively into relation with the symphysis and anterior abdominal wall.

Its base is partially covered by peritoneum, and limits anteriorly the recto-vesical pouch, which separates it from the rectum and pelvic colon. It has in contact with it on either side the vesicula seminalis and vas deferens. The vasa deferentia, converging as they approach the prostate, leave a small triangular space between them, the base of which is above, and is formed by the line of reflexion of the

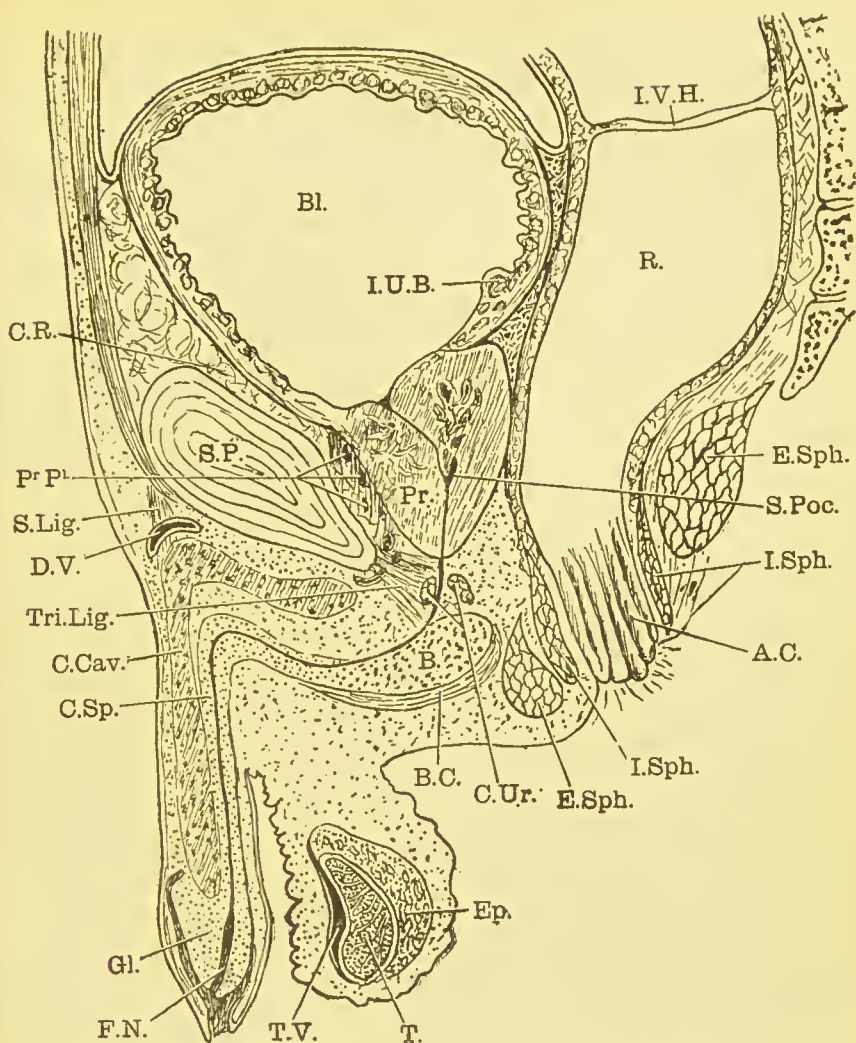


FIG. 272.—MEDIAN SAGITTAL SECTION THROUGH THE MALE PELVIS.
(TRACED FROM NATURE WITH A DIAGRAPH.)

C.R. Cave of Retzius. *S.P.* Symphysis Pubis. *Pr.Pl.* Prostatic Plexus. *S.Lig.* Suspensory Ligament of Penis. *D.V.* Dorsal Vein. *Tri.Lig.* Triangular Ligament. *C.Cav.* Corpus Cavernosum. *C.Sp.* Corpus Spongiosum. *Gl.* Glans. *F.N.* Fossa Navicularis. *T.V.* Tunica Vaginalis. *T.* Testis. *Ep.* Epididymis. *Bl.* Bladder. *I.U.B.* Section of Interureteric Bar. *Pr.* Prostate. *B.* Bulb. *B.C.* Bulbo-cavernosus. *C.Ur.* Compressor Urethrae. *E.Sph.* External Sphincter. *I.Sph.* Internal Sphincter. *I.V.H.* Lowest Valve of Houston. *R.* Rectum. *A.C.* Anal Canal. *S.Poc.* Sinus Pocularis.

peritoneum. In this triangle the wall of the rectum and bladder are in contact, and here the bladder used to be punctured, through the rectum, with a long curved trochar and canula.

To the apex of the bladder is attached the *urachus*,

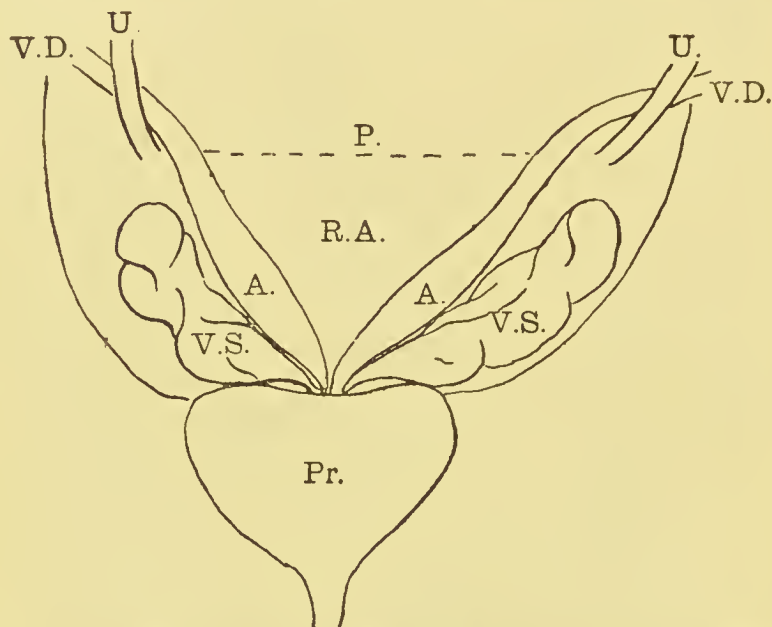


FIG. 273.—THE POSTERIOR SURFACE OR BASE OF THE BLADDER.

U. Ureter. *V.D.* Vas Deferens. *A.* Ampulla of Vas Deferens. *V.S.* Vesicula Seminalis. *P.* Line of Reflexion of Peritoneum on to the Rectum. *R.A.* Triangle uncovered by Peritoneum in contact with the Rectal Ampulla. *Pr.* Prostate.

a fibrous cord running upwards to the umbilicus, and representing the remains of the allantois.

Traced downwards, the surfaces of the bladder converge to form an ill-defined neck, which at the base of the prostate opens into the urethra.

Laterally, the bladder is in relation to the side-walls of the pelvis, from which, however, it is separated by cellular tissue containing branches of the internal iliac vessels.

From the upper part of each side of the bladder the peritoneum is reflected off on to the side-wall of the pelvis, thus forming the *lateral false ligaments* [plicæ vesicales transversæ]; its point of reflexion is determined by the *obliterated hypogastric artery*—a fibrous cord continuing the superior vesical artery up to the umbilicus. Anteriorly, the peritoneum is lifted off the apex of the bladder by the urachus and forms the *superior false ligament* [plicæ pubovesicalis], while posteriorly, two folds of peritoneum run, one to each side of the rectum, forming the side-walls of the recto-vesical pouch, and known as the *posterior false ligaments*.

It will thus be seen that all five *false ligaments* of the bladder are formed of peritoneum, and that the obliterated hypogastric arteries and urachus form three *fœtal ligaments*. There are, in addition, three *true ligaments* described, which are formed from the pelvic fascia. They are all attached near the neck of the bladder, and are anterior and two lateral. The anterior true ligament runs forward to the symphysis pubis, while the two lateral run outwards to the origins of the levatores ani or white lines of Henle.

These so-called true ligaments are merely condensed parts of the cellular bed in which the bladder lies.

The VESICULÆ SEMINALES lie behind the bladder and above the posterior part of the base of the prostate, which projects, like a narrow shelf, behind the level of the bladder to support them. Each is $1\frac{1}{2}$ to 2 inches long, and resembles a pear flattened from before backwards (see Fig. 273).

The *vasa deferentia* [ductus deferentes] have been seen entering the abdomen at the internal abdominal ring, and traced as far as the ischial spine. As they approach the base of the bladder they become enlarged and sacculated, forming the *ampullæ*.

Lying to the inner side of the vesiculæ seminales, the vas joins the apex of the vesicula to form the *common ejaculatory duct*, which disappears from view within the prostate.

The PROSTATE lies some little distance below the peritoneum, and is surrounded by a considerable amount of cellular tissue, which forms its so-called capsule. In removing this tissue a venous plexus should be sought lying among the layers of fascia—the *prostatic plexus*. The capsule being removed, the prostate will be seen to have the size and shape of a Spanish chestnut, that is to say, it is an inverted pyramid having three surfaces, a base and an apex. The

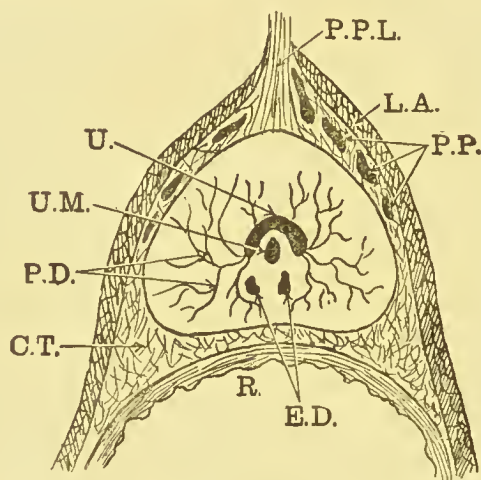


FIG. 274.—HORIZONTAL SECTION THROUGH THE PROSTATE SHOWING THE TWO ANTERO-LATERAL AND THE CONCAVE POSTERIOR SURFACE. (DIAGRAMMATIC.)

P.P.L. Pubo-prostatic Ligament. *L.A.* Levator Ani. *P.P.* Prostatic Plexus. *U.* Urethra. *U.M.* Sinus Pocularis, or Uterus Masculinus. *P.D.* Prostatic Ducts opening into Prostatic Sinus. *C.T.* Cellular Tissue. *E.D.* Ejaculatory Ducts. *R.* Rectal Ampulla.

surfaces are two antero-lateral and one posterior, the two former meeting at the rounded anterior border, which fits into the re-entering angle formed by the converging levatores ani muscles. It forms a collar round the first part of the urethra $1\frac{1}{4}$ inch deep. At the posterior part of its base it is traversed by a small transverse fissure, at which enter the common ejaculatory ducts formed by the union of the vesiculæ seminales and vasa deferentia.

The relations of the Prostate are as follows: Superiorly (basal surface), the bladder, vesiculæ seminales, and vasa deferentia; antero-laterally, the levatores ani muscles, inferiorly the membranous urethra. The cellular tissue between the gland and the symphysis is dense and fibrous, constituting the *pubo-prostatic ligaments*. Posteriorly lies the rectum, which makes the posterior surface somewhat concave from side to side (see Fig. 274).

THE BLOOD VESSELS OF THE PELVIS

At this stage, before the viscera are removed, the blood vessels should be reviewed.¹ As the pelvis was removed from the abdomen by cutting through the disc between the fourth and fifth lumbar vertebræ, the common iliac vessels will be found in the lower segment. The bifurcation of the aorta is opposite the lower part of the fourth lumbar vertebra, and from it the *common iliac arteries* run downwards and outwards to the sides of the lumbo-sacral articulation.

On both sides the artery has the ureter and ovarian vessels (if the subject be a female) in front of its termination as well as, on the right, the ileum, superior mesenteric vessels, and mesentery in front of its course. On the left side these latter structures are replaced by the pelvic colon and meso-colon and the inferior mesenteric vessels. Behind are the fifth lumbar vertebra, and the two discs adjacent to it, the sympathetic chain, the common iliac vein, and, more deeply, the obturator nerve. Notice that the right common iliac artery has three great veins in relation to it, the two common iliacs, and the vena cava, while the left common iliac artery only has its own vein to the right and behind it.

From the point of bifurcation of the common iliac trace the *external iliac artery* along the inner side of the psoas

¹ If during this dissection more room is really needed, one pelvic wall may be removed as directed on p. 230.

muscle to a point midway between the anterior superior spine

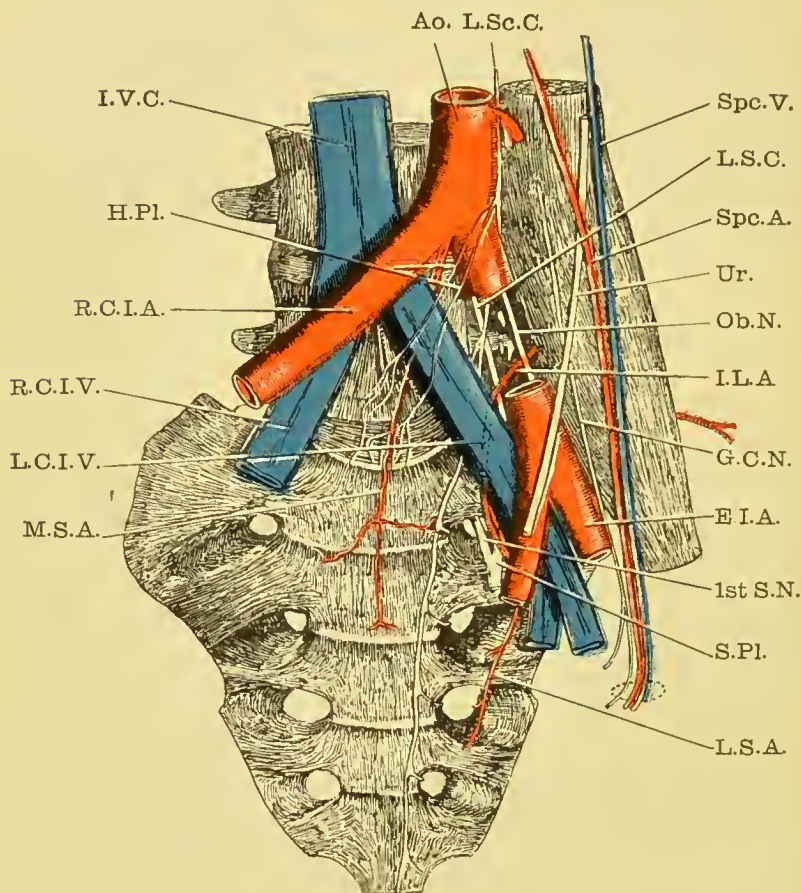


FIG. 275.—RELATIONS OF THE COMMON ILIAC ARTERIES.

Ao. Aorta. *I.V.C.* Inferior Vena Cava. *H.Pl.* Nerves to Hypogastric Plexus. *R.C.I.A.* Right Common Iliac Artery. *R.C.I.V.* Right Common Iliac Vein. *L.C.I.V.* Left Common Iliac Vein. *M.S.A.* Middle Sacral Artery. *L.Sc.C.* Left Sympathetic Cord. *Spc.V.* Spermatic Vein. *Spc.A.* Spermatic Artery. *L.S.C.* Lumbo-sacral Cord. *Ur.* Ureter. *Ob.N.* Obturator Nerve. *I.L.A.* Ilio-lumbar Artery. *G.C.N.* Genito-crural Nerve. *E.I.A.* External Iliac Artery. *1st S.N.* First Sacral Nerve. *S.Pl.* Upper Part of Sacral Plexus. *L.S.A.* Lateral Sacral Artery.

and the symphysis pubis. As Poupart's ligament is approached, the artery lies more in front of the psoas.

The two branches of this artery are the *deep epigastric* and the *deep circumflex iliac*, the former of which has been

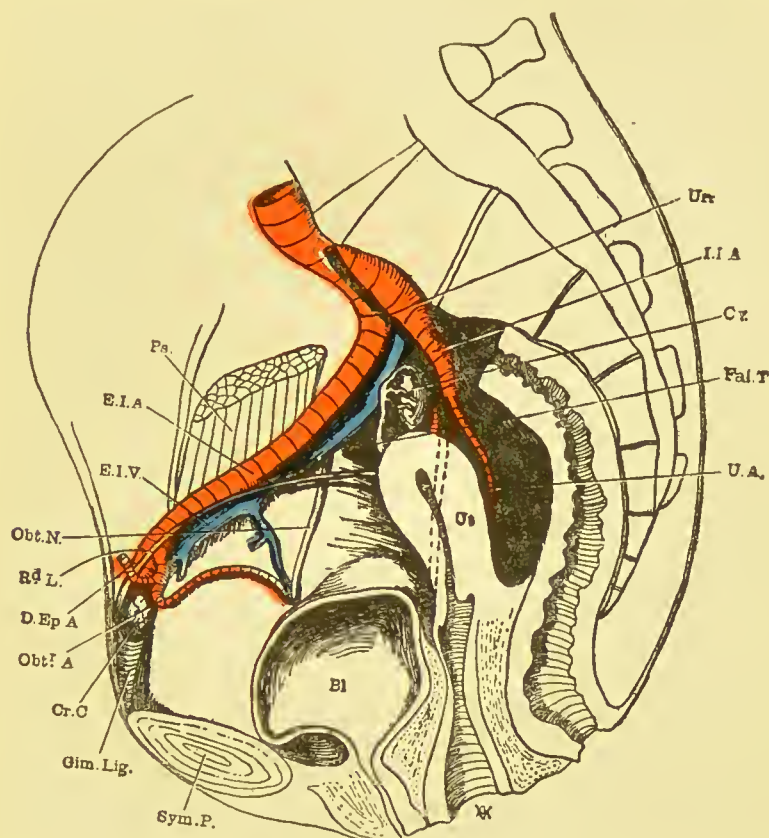


FIG. 276.—DISSECTION OF THE FEMALE PELVIS TO SHOW THE ILIAC ARTERIES AND THE OCCASIONAL ORIGIN OF THE OBTURATOR ARTERY FROM THE DEEP EPIGASTRIC. (FROM THE DISSECTING-ROOM OF ST. THOMAS'S HOSPITAL.)

Ur. Ureter. *I.I.A.* Internal Iliac Artery. *Ov.* Ovary. *Fal.T.* Fallopian Tube. *U.A.* Uterine Artery (having an abnormal relation to the Ureter). *Ps.* Psoas. *E.I.A.* External Iliac Artery. *E.I.V.* External Iliac Vein. *Obt.N.* Obturator Nerve. *R^d.L.* Round Ligament. *D.Ep.A.* Deep Epigastric Artery. *Obt.A.* Obturator Artery. *Cr.C.* Crural Canal containing a Lymph Node. *Gim.Lig.* Gimbernat's Ligament. *Bl.* Bladder. *Ut.* Uterus.

seen already (see pp. 86, 87), while the latter runs outwards to the iliac crest behind Poupart's ligament.

Notice that the *external iliac vein* lies below, behind, and internal to its artery. Three or four *external iliac lymph*

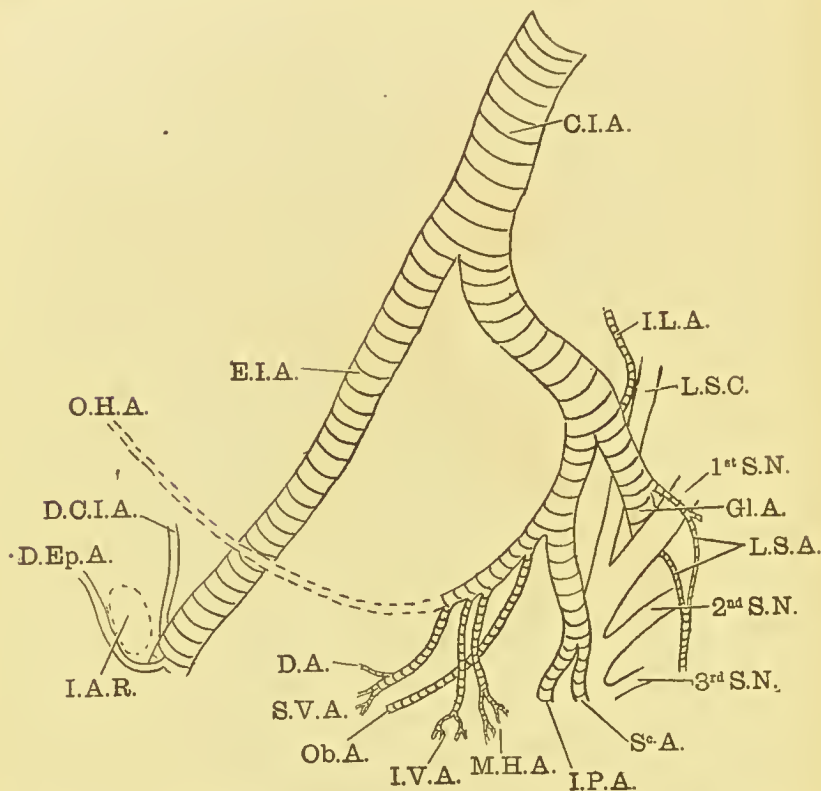


FIG. 277.—SCHEME OF THE PELVIC ARTERIES VIEWED FROM THE MID LINE.

C.I.A. Common Iliac Artery. *E.I.A.* External Iliac Artery. *D.Ep.A.* Deep Epigastric Artery. *D.C.I.A.* Deep Circumflex Iliac Artery. *I.A.R.* Internal Abdominal Ring. *I.L.A.* Ilio-lumbar Artery rising from the Posterior Division of the Internal Iliac Artery. *L.S.C.* Lumbo-sacral Cord. *1st, 2nd, 3rd S.N.* Corresponding Sacral Nerves. *Gl.A.* Gluteal Artery. *L.S.A.* Lateral Sacral Artery. *Sc.A.* Sciatic Artery. *I.P.A.* Internal Pudic Artery. *M.H.A.* Middle Hæmorrhoidal Artery. *I.V.A.* Inferior Vesical Artery. *Ob.A.* Obturator Artery. *S.V.A.* Superior Vesical Artery. *D.A.* Deferential Artery. *O.H.A.* Obliterated Hypogastric Artery.

nodes should be looked for close to the vein. Next follow the *internal iliac artery* [a. hypogastrica] backwards along

the root of the pelvis for about $1\frac{1}{2}$ inch, until the upper margin of the great sacro-sciatic notch is reached. It lies just above and behind the ureter when the body is erect (see Fig. 276), and its vein is behind and internal.

At this point it divides into an anterior and a posterior division.

The *anterior division* is chiefly concerned with the supply of the pelvic viscera, and the first branch to be looked for is the *superior vesical*, which reaches the bladder through the posterior false ligaments, and, when it comes in contact with the vas deferens, gives off the small deferential artery.

The *inferior vesical* comes off quite close to the last, or by a common trunk with it, and supplies the ampulla of the vas deferens and vesicula seminalis. Both these branches are in close relation to the end of the ureter, and give small twigs to it.

The *middle hæmorrhoidal* is always closely associated at its origin with the vesical branches; it usually enters the side of the rectum about the level of the base of the prostate, and gives several branches to this gland.

It is important to realise that the obliterated hypogastric artery is the real continuation of the internal iliac, and that, strictly speaking, all the pelvic branches come from that stem. In the fœtus this artery forms a downwardly-directed loop from the bifurcation of the common iliac to the umbilicus, and it is from the downward convexity of this loop that all the pelvic branches spring.

The vesical and middle hæmorrhoidal arteries, which are dissected first, are really the last branches given off by the hypogastric on its way to the umbilicus, and when the umbilical cord is tied in the fœtus the artery becomes obliterated from the umbilicus to the point of origin of the superior vesical artery.

This *obliterated hypogastric artery* is very evident in the adult running along the side of the pelvis towards the anterior abdominal wall.

The *Obturator Artery* rises from the hypogastric loop behind the branches already mentioned, and runs forwards to the obturator foramen below the obturator nerve. It is very variable in size, and sometimes is a branch of the deep epigastric (see Fig. 276, Obt. A.).

The *Internal Pudic* [a. pudenda interna] and *Sciatic Arteries* rise by a common trunk from the hypogastric behind the origin of the obturator. They separate from one another near the lower border of the pyriformis muscle, and leave the pelvis through the great sacro-sciatic notch below this muscle, the internal pudic being in front and the sciatic behind.

The common trunk which these arteries form is usually described as the continuation of the anterior division of the internal iliac.

The *Posterior Division of the Internal Iliac Artery* is originally a branch of the hypogastric which rises behind the common origin of the sciatic and internal pudic, and leaves the pelvis as the *gluteal artery* above the upper border of the pyriformis muscle. It passes between two nerves, which will later be recognised as the lumbo-sacral cord and the first sacral nerve.

This posterior division soon gives off the *Ilio-lumbar Artery*, which runs upwards and outwards between the obturator nerve and the lumbo-sacral cord to disappear deep to the psoas muscle (see Fig. 275, p. 204). On one side the psoas and iliacus muscles may be cleared away far enough to follow this branch, care being taken not to cut any nerves met with. When this is done the artery will be found to divide into an *iliac branch*, which supplies the iliac fossa, and a *lumbar branch*, which passes upwards and backwards between the transverse process of the last lumbar vertebra and the sacrum to supply the lower part of the spinal canal. The resemblance of this lumbar branch to the posterior branch of a typical lumbar or intercostal artery will be evident.

The *Lateral Sacral Arteries*, usually two on each side, run

inwards behind the posterior division of the internal iliac vein to the anterior sacral foramina. The upper artery disappears through the first of these foramina, but the lower runs down on the inner side of the lower foramina, through which it gives small spinal branches, and anastomoses freely with the middle sacral artery, which is running down the front of the sacrum in the mid line.

On the inner side of the lateral sacral arteries look for the *sympathetic cord*, which in the sacral region usually has five ganglia. In front of the coccyx the two cords of opposite sides meet in a small ganglion known as the *ganglion impar*.

In dissecting the arteries of the pelvis, a large number of veins will have to be removed. They drain the vesical and prostatic plexuses and the lower part of the rectal or hæmorrhoidal plexus into the internal iliac veins. It is very important to notice that the upper and greater part of the hæmorrhoidal plexus drains upwards into the inferior mesenteric vein and so into the portal system.

Internal Iliac Lymph Nodes are found along all the branches of the internal iliac artery, but the largest are at the upper part of the great sacro-sciatic notch.

Sacral Lymph Nodes should also be looked for close to the sacra media artery.

EXAMINATION OF THE PELVIC VISCERA

The pelvic viscera should now be removed and their structure examined.

The prostate should be carefully drawn up from the trough which the two levatores ani muscles form for it. Some fibres of these muscles, as well as the pubo-prostatic ligament, must be carefully divided, after which the prostate will be lifted easily, and the urethra may be divided below it, preferably with scissors. The rectum should be divided where the levator ani is closing round it; this means that

the anal canal, as the last inch of the gut is called, is left in the floor of the pelvis.

At the end of the *pelvic colon* the anterior and external *tæniæ coli* may be seen to come together to form a single band, while by the time the rectum is reached the longitudinal fibres of the large intestine are arranged uniformly round the gut. Within these the gut is surrounded by circular fibres, which are augmented in the region of the anal canal to form the internal sphincter. The *external sphincter* is situated outside the longitudinal fibres.

If the rectum be now slit open by a medial incision its mucous membrane will be exposed, and some prominent shelf-like folds, known as the *valves of Houston* [*plicæ transversales recti*], will be seen. As a rule, there are two of these, one on the right, the other on the left side, but occasionally three, or even four, are found. One of them, usually the lowest, is situated opposite the point whence the peritoneum is reflected from the rectum to the bladder or uterus, as the case may be.

It is believed that normally the *fæces*, except during defæcation, lie above the valves. The mucous membrane of the rectum is vascular, thick and soft, particularly when compared with that of the anal canal. It is marked on its surface by a number of small apertures, the mouths of rectal pits, which contain a considerable amount of lymphoid tissue in their walls.

The last inch of the rectum is known as the *anal canal*, and is closed in life by the apposition of the two lateral walls. Its direction is downwards and backwards, and it is surrounded by the sphincter muscles. Unless the anus is excised this part of the gut will probably be left in the perineum, and should be examined there.

The lumen of the anal canal is much smaller than that of the rectum, and the change from the one part of the tube to the other is usually particularly abrupt, because that part of the rectum which lies between the lower valve of Houston

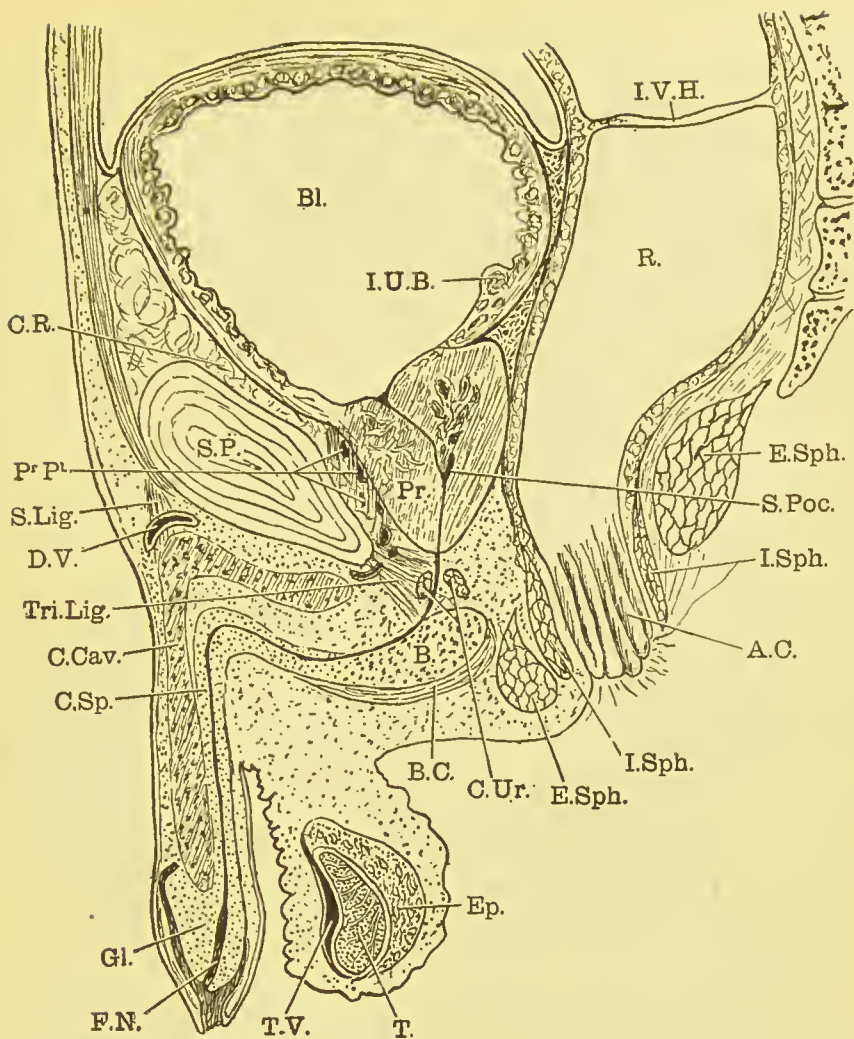


FIG. 278.—MEDIAN SAGITTAL SECTION THROUGH THE MALE PELVIS.
(TRACED FROM NATURE WITH A DIAGRAPH.)

C.R. Cave of Retzius. *S.P.* Symphysis Pubis. *Pr.Pl.* Prostatic Plexus. *S.Lig.* Suspensory Ligament of Penis. *D.V.* Dorsal Vein. *Tri.Lig.* Triangular Ligament. *C.Cav.* Corpus Cavernosum. *C.Sp.* Corpus Spongiosum. *Gl.* Glans. *F.N.* Fossa Navicularis. *T.V.* Tunica Vaginalis. *T.* Testis. *Ep.* Epididymis. *Bl.* Bladder. *I.U.B.* Section of Interureteric Bar. *Pr.* Prostate. *B.* Bulb. *B.C.* Bulbo-cavernosus. *C.Ur.* Compressor Urethrae. *E.Sph.* External Sphincter. *I.Sph.* Internal Sphincter. *I.V.H.* Lowest Valve of Houston. *R.* Rectum. *A.C.* Anal Canal. *S.Poc.* Sinus Pocularis.

and the anal canal is capable of considerable distension, and is known as the *rectal ampulla*.

The mucous membrane of the anal canal, too, is thinner and less vascular than that of the rectum, and is remarkable in its upper part for the presence of a series of vertical ridges known as the *columns of Morgagni* [columnæ rectales]. These are united with one another below by a series of

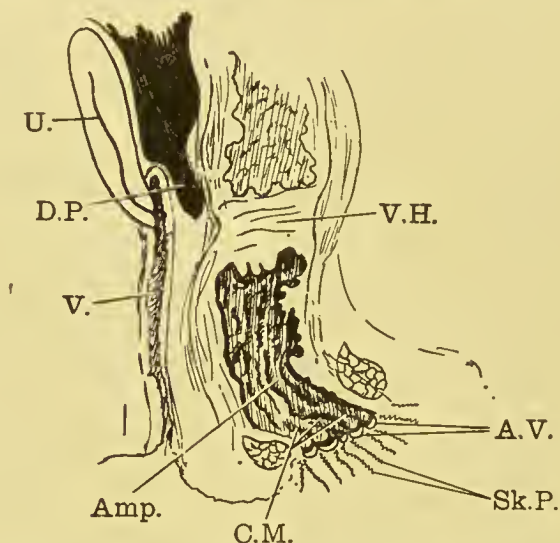


FIG. 279.—SAGITTAL SECTION OF THE RECTUM OF A FEMALE INFANT TO SHOW THE ANATOMY OF THE ANAL CANAL. (TRACED WITH A DIAGRAPH.)

U. Uterus. *D.P.* Pouch of Douglas. *V.* Vagina. *V.H.* Lowest Valve of Houston. *Amp.* Rectal Ampulla. *C.M.* Columns of Morgagni. *A.V.* Anal Valves. *Sk.P.* Puckers in the Skin round the Anus.

crenate folds, which are known as the *anal valves*, and tend to disappear in later life.

It is in these columns that the anastomosis between the superior, middle, and inferior hæmorrhoidal vessels takes place.

Now divide the bladder in the antero-median line along its whole length, and continue the incision along the whole length of the upper surface of what remains of the urethra.

If the lips of the incision be now drawn apart, a good view will be obtained of the interior of the bladder and prostatic urethra.

The mucous membrane lining the bladder is rugose everywhere, except over a triangular area on the posterior wall, just above the *internal urinary meatus*, the entrance into the urethra. This area is known as the *trigonum vesicæ*, and is clearly circumscribed. The base of the

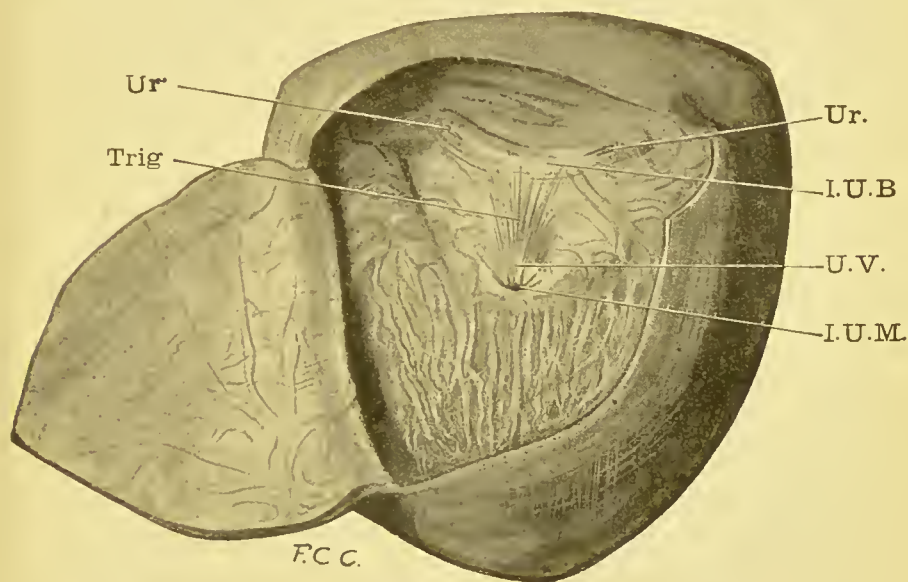


FIG. 280.—THE BLADDER OPENED FROM ABOVE.

Ur. Ureter. *Trig.* Trigonum Vesicæ. *I.U.B.* Interureteric Bar
U.V. Uvula Vesicæ. *I.U.M.* Internal Urinary Meatus

triangle is above, the apex at the meatus. At the basal angles of either side a slit-like aperture will be seen—the opening of the ureter. The rugosity of the remainder of the mucous membrane is attributable to varying distension which the bladder undergoes (see Fig. 280).

It will be seen that the two openings of the ureters are about an inch apart, while the openings of the ureters into the exterior of the bladder are two inches apart; it is there-

fore evident that each ureter runs obliquely through the wall of the bladder for more than half an inch. This oblique piercing causes a functional valve of great competence.

Running across the base of the trigonum is a transverse ridge joining the internal openings of the two ureters, and therefore known as the *inter-ureteric bar* [plica ureterica]; it is caused by a band of muscle, and is of great importance in examining the interior of the living bladder with the cystoscope, since, if followed outwards in either direction, it leads to the ureteric openings. Each of these openings is about an inch from the urethral orifice, so that the trigonum is an equilateral triangle, each wall of which is one inch.

A small heaping up of the submucous tissue at the apex of the trigonum produces a low-lying eminence, which has received the name of the *uvula vesicæ*. From the uvula there stretches into and along the floor of the prostatic portion of the urethra a well-marked median ridge, the *verumontanum* [colliculus seminalis]. In front of the highest point of the ridge is a small slit-like aperture, the opening of the *sinus pocularis* [utriculus prostaticus], just within the orifice of which are the openings one on either side of the common ejaculatory ducts. A bristle passed through one of these ducts from the incised ampulla will show where it opens, though without this aid the orifice can seldom be distinguished. On each side of the verumontanum is a longitudinal depression—the *prostatic sinus*—into which the ducts of the prostate mostly enter. These, however, are not visible to the naked eye.

As a rule, the median section of the bladder resembles that of a pear, all the boundaries being convex outwards. Occasionally, however, what is known as a “diastolic bladder” is found in which all the boundaries are concave outwards. This is probably due to the normal muscular contraction having passed off, or to the bladder having been emptied after death.

Now dissect the various coats of the bladder on one

side. Notice the extent of the *peritoneal coat* with the *subperitoneal* between it and the muscular tissue. This subperitoneal coat is continuous with the pelvic cellular tissue at the sides and back of the bladder. Dissect away the external longitudinal muscular coat, the middle circular and the inner reticulated, noticing that, when the inner coat is hypertrophied, pouches of the mucous membrane may form in gaps between its bundles. The absence of sub-

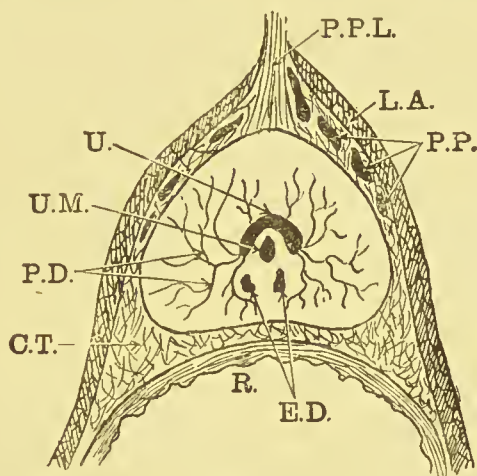


FIG. 281.—HORIZONTAL SECTION THROUGH THE PROSTATE SHOWING THE TWO ANTERO-LATERAL AND THE CONCAVE POSTERIOR SURFACE. (DIAGRAMMATIC.)

P.P.L. Pubo-prostatic Ligament. *L.A.* Levator Ani. *P.P.* Prostatic Plexus. *U.* Urethra. *U.M.* Sinus Pocularis, or Uterus Masculinus. *P.D.* Prostatic Ducts opening into Prostatic Sinus. *C.T.* Cellular Tissue. *E.D.* Ejaculatory Ducts. *R.* Rectal Ampulla.

mucous tissue in the trigonum explains the smoothness of the mucous membrane there, and the absence of rugosities, since, when the mucous membrane is firmly bound to the muscular walls, no ridges are possible.

Now make a transverse section through the prostate and prostatic urethra, and notice the crescentic appearance of the latter. Identify the sinus pocularis and the common ejaculatory ducts. The structure of the prostate is not

homogeneous, since cortical and medullary portions can be distinguished; the former is fibro-muscular, the latter mainly glandular, but traversed by strands of cortical tissue. Below the bladder is the *prostatic urethra*, about an inch and a quarter long and nearly half an inch from side to side. As it is a little constricted at either end, it has a somewhat fusiform appearance. In a sagittal mesial section through the prostate the prostatic urethra runs at first downwards and then turns a little forwards as well (see Fig. 278).

THE PELVIC FLOOR FROM ABOVE.—It will be seen now that the levator ani, coccygeus and pyriformis muscles form a pelvic diaphragm or muscular floor to the pelvis. Look carefully for a linear thickening of the fasciæ covering the inner surface of the obturator internus, stretching from the back of the body of the pubis to the ischial spine. This is known as the *white line of Henle*, and from it and its two bony attachments the levator ani hangs like a curtain from its curtain-rod.

DISSECTION OF THE FEMALE PELVIS

The description already given of the male pelvis applies equally well to that of the female in all particulars except those relating to the uro-genital system. In the male, at the base of the bladder, the vesiculæ seminales and the vasa deferentia were found, while, surrounding the first part of the urethra, was the prostate. In the female between the rectum and bladder, the uterus and vagina are situated, while, extending outwards, backwards and upwards from the uterus, is the wing-like broad ligament enclosing in its free border the Fallopian tube, and having the ovary projecting backwards from it. Consequent upon these changes in the viscera there is a corresponding change in the visceral branches and tributaries of the internal iliac vessels and in the peritoneal folds and fossæ.

The recto-vesical pouch will be seen to be divided trans-

versely by the uterus and its broad ligament into a posterior part, the *recto-uterine* or *Douglas's pouch*, and an anterior utero-vesical pouch. The former is deeper than the latter, and is occupied by coils of small intestine and pelvic colon.

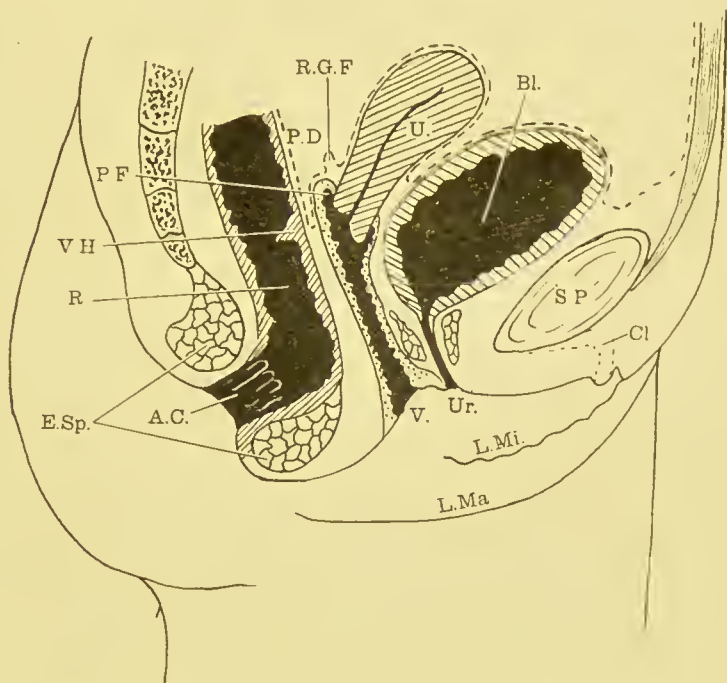


FIG. 282.—MESIAL SAGITTAL SECTION OF THE FEMALE PELVIS.
(SEMI-DIAGRAMMATIC.)

Bl. Bladder. *S.P.* Symphysis Pubis. *U.* Uterus. *R.G.F.* Recto-genital Fold. *P.D.* Pouch of Douglas. *P.F.* Posterior Fornix of Vagina. *V.H.* Lower Valve of Houston opposite the Reflexion of the Peritoneum. *R.* Rectum. *E.Sp.* External Sphincter. *A.C.* Anal Canal. *V.* Orifice of Vagina. *Ur.* Orifice of Urethra. *L.Mi.* Labium Minus. *L.Ma.* Labium Majus. *Cl.* Clitoris.

Its depth should be estimated by passing one finger down to its floor and another into the posterior fornix of the vagina. It will then be noted that the floor of the pouch is lower than the roof of the vagina.

It is most important to realise that this pouch of Douglas

is in contact with the posterior fornix of the vagina, since, in unskilled attempts to procure abortion, instruments have been pushed from the vagina into the peritoneal cavity and fatal peritonitis caused.

The utero-vesical pouch normally is empty and almost obliterated by the close apposition of the anterior surface of the uterus to the base and superior surface of the bladder. In many cases, however, found in the dissecting-room the uterus is bent backwards and lies in apposition to the rectum, the recto-uterine pouch being a mere fissure, while the utero-vesical is large and open.

The utero-vesical pouch is limited laterally by two peritoneal folds which pass from the uterus to the internal abdominal ring; they enclose the round ligaments of the uterus, to be described later, but which have been mentioned already in the description of the inguinal canal. After the abdomen has been opened, the round ligaments are relaxed, and are much less prominent than they were originally.

Having noticed these peritoneal arrangements, the student should next study the viscera, so far as this is possible without removing any peritoneum. The uterus should be firmly grasped between the fingers and thumb of one hand and lifted up out of the pelvis, thus showing its great mobility. With the thumb and fingers of the other hand the limits of the viscus can be defined. It will be observed to be flask-shaped, with its fundus above and neck below. If the uterus be now pulled upwards and to one side, a good view of the *broad ligament* [lig. latum uteri] will be obtained stretching from the lateral surface of the uterus to the inner surface of the lateral wall of the pelvis. Now roll the upper border of the ligament between the fingers and thumb and the round *Fallopian tube* [tuba uterina] will be easily felt. Trace the tube inwards to the uterus and outwards to the ovary around which it ends; its walls are here cut up into a number of fringe-like processes—the *fimbriæ*—one of which, the *fimbria ovarica*, is constantly attached to the upper and outer pole

of the ovary. The *ovary* is of a broad almond-shape slung between the uterus and the lateral wall of the pelvis, and attached anteriorly to the posterior surface of the broad ligament. The band which connects it with the uterus is a rounded cord known as the *ligament of the ovary* [lig. ovarii proprium], while that which connects it with the pelvic wall is the *ovario-pelvic ligament*, in which it is possible to feel, through the peritoneum, the ovarian vessels as they are passing down from the abdomen. The fimbriæ of the Fallopian tube will be seen to lie in close relation to the ovary.

A similar dissection to that already described for the male pelvis should now be carried out. Make an incision in the median plane through the peritoneum from the right side of the beginning of the pelvic colon to the symphysis pubis, and remove all the peritoneum from the right half of the pelvis. In this way the structures will be left *in situ*, and the left half can be used for comparison. Clean as before the cellular tissue away from the viscera, preserving all the blood vessels, lymphatics and nerves. This cellular tissue is of great clinical importance, since inflammation is liable to spread into it from the uterus, causing the condition known as "para-metritis." The branches from the internal iliac artery in the female correspond to those in the male, except that a *vaginal branch* replaces the inferior vesical, and there is an additional *uterine artery* (see p. 224).

The *ovarian artery*, which corresponds, of course, to the spermatic in the male, enters the pelvis at the upper end of the ovario-pelvic ligament, within which it is conducted to the ovary, supplying branches not only to that organ but to the Fallopian tube and to the uterus. It is accompanied by the ovarian veins, which in the ovario-pelvic and broad ligaments form a plexus with those coming from the uterus.

The *ureter* should next be traced from the brim of the pelvis to where it opens into the bladder. So far as the

ischial spine, its course is identical in the two sexes, but from this point in the female it takes a bow-shaped course around

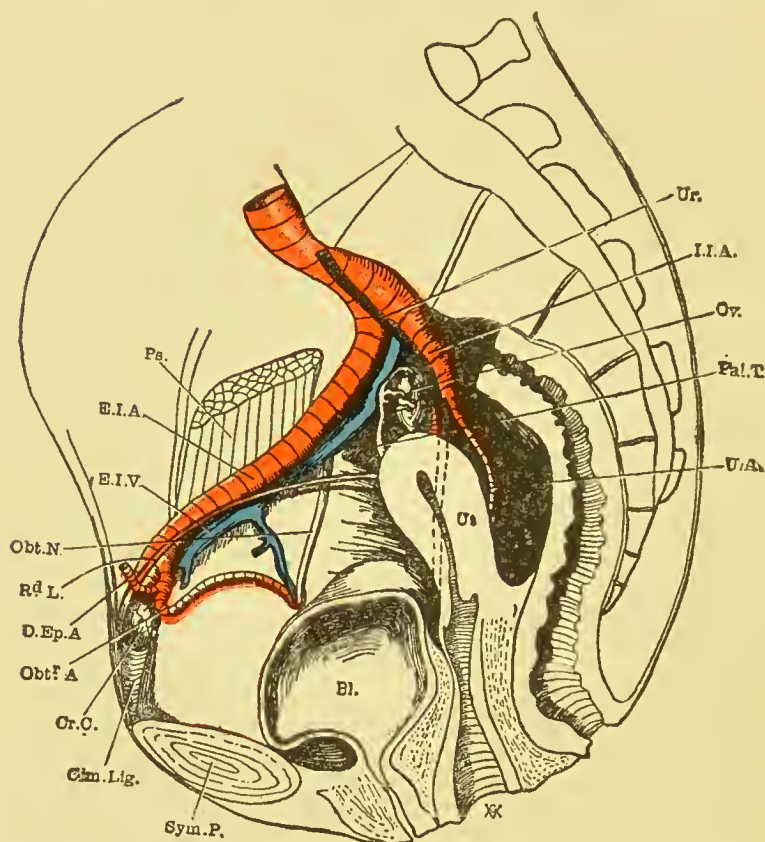


FIG. 283.—DISSECTION OF THE FEMALE PELVIS TO SHOW THE POSITION OF THE OVARY TO THE FALLOPIAN TUBE AND THE COURSE OF THE URETER.

Ur. Ureter. *I.I.A.* Internal Iliac Artery. *Ov.* Ovary. *Fal.T.* Fallopian Tube. *U.A.* Uterine Artery (having an abnormal relation to the Ureter). *Ps.* Psoas. *E.I.A.* External Iliac Artery. *E.I.V.* External Iliac Vein. *Obt.N.* Obturator Nerve. *Rd.L.* Round Ligament. *D.Ep.A.* Deep Epigastric Artery. *Obt.A.* Obturator Artery. *Cr.C.* Crural Canal containing a Lymph Node. *Gim.Lig.* Gimbernat's Ligament. *Bl.* Bladder. *Ut.* Uterus.

the neck of the uterus, from which it lies at its nearest point three-fifths of an inch. Here it is just above the lateral

fornix of the vagina, and can be sometimes felt if a finger is placed there.

In cleaning the ureter a large number of lymphatics may be found running transversely outwards, both in front of and behind the duct. These are lymphatic vessels from the cervix uteri and are of considerable importance, since this portion of the uterus is the most common site of cancer in

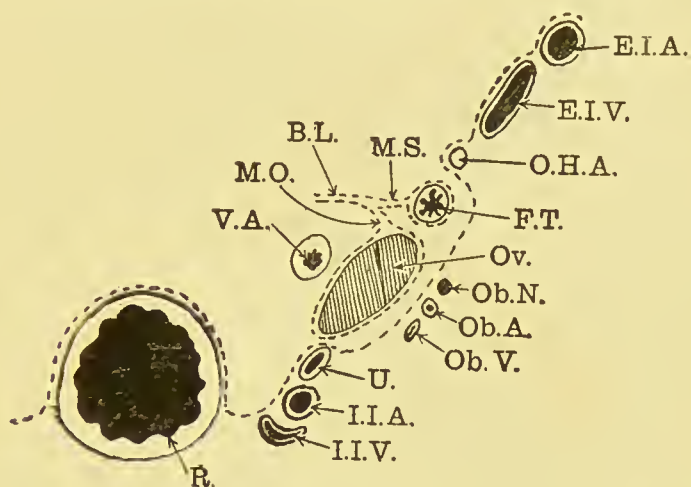


FIG. 284.—DIAGRAMMATIC HORIZONTAL SECTION THROUGH THE RIGHT SIDE OF THE PELVIS TO SHOW THE RELATIONS OF THE OVARY.

E.I.A. External Iliac Artery. *E.I.V.* External Iliac Vein. *O.H.A.* Obliterated Hypogastric Artery. *F.T.* Fallopian Tube. *B.L.* Broad Ligament. *M.S.* Meso-salpinx. *M.O.* Mesovarium. *Ov.* Ovary. *V.A.* Vermiform Appendix. *Ob.N.* Obturator Nerve. *Ob.A.* Obturator Artery. *Ob.V.* Obturator Vein. *U.* Ureter. *I.I.A.* Internal Iliac Artery. *I.I.V.* Internal Iliac Vein. *R.* Rectum.

the whole body. They drain into the internal iliac nodes, while those from the fundus and Fallopian tubes pass upwards to the aortic nodes.

Notice carefully the position of the ovary and Fallopian tube. The former lies with its long axis nearly vertical at the side of the true pelvis below the bifurcation of the common iliac artery. Sometimes there is a definite triangular

fossa (*fossa ovarica*) for its reception, bounded above by the

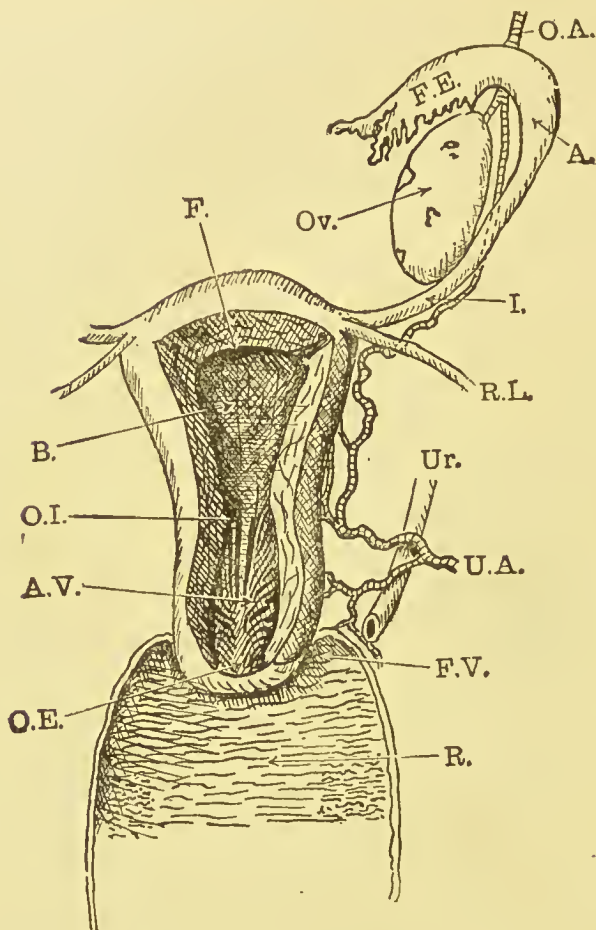


FIG. 285.—THE UTERUS AND APPENDAGES OF A WOMAN ÆT. 19 YEARS .
THE SPECIMEN HAS BEEN OPENED FROM IN FRONT.

F. Fundus. *B.* Body. *O.I.* Os Internum. *A.V.* Cervix showing the Arbor Vitæ arrangement of the Mucous Membrane. *O.E.* Os Externum. *R.* Vagina laid open to show the Rugæ. *F.V.* Lateral Fornix of Vagina. *U.A.* Uterine Artery. *Ur.* Ureter. *R.L.* Round Ligament. *I.* Isthmus of Fallopian Tube. *A.* Ampulla. *F.E.* Fimbriated Extremity. *O.A.* Ovarian Artery. *Ov.* Ovary.

obliterated hypogastric artery and behind by the ureter. Across the floor of this fossa runs the obturator nerve. It

is not unusual, on the right side, to find the vermiform appendix lying in contact with the front of the ovary.

To map out the ovary on the anterior abdominal wall join the anterior superior iliac spine to the spine of the opposite pubis, and bisect this line. The ovary lies three or four inches directly behind this point.

The Fallopian tube runs at first outwards and then turns upwards along the antero-external border of the ovary, where the latter organ is attached to the broad ligament by the fold known as the *mesovarium*. On reaching the top of the ovary, which is known as the *tubal pole*, the tube turns backwards and inwards and ends in its fimbriated extremity.

It will thus be seen that the normal ovary has one surface looking forwards and inwards towards the bladder, and another backwards and outwards against the pelvic wall.

One border is forwards and outwards in contact with the Fallopian tube, and another backwards and inwards looking towards the rectum (see Fig. 284).

The upper end or *tubal pole* receives the ovarian vessels, and is in contact with the fimbriated extremity of the tube, while the lower end or *uterine pole* is attached by the ligament of the ovary to the uterus.

The pelvic floor will be seen to be formed in a similar way to that already described in speaking of the male pelvis, viz. by the coccygeus and levatores ani muscles. The latter muscle has a large aperture in its anterior portion for the passage of the vagina, its anterior fibres being sometimes known as the *levator vaginae muscle*. By drawing the viscera to one side it is usually possible to expose the pelvic floor and the side of the vagina, and it is well for the student to accustom himself as far as may be to the conditions he may have to face later on in the living body. If, however, more room is absolutely necessary, it may be obtained by removing one side of the pelvic wall as directed on p. 230.

By this procedure good access will be gained to the

cavity of the pelvis, and the various structures already identified can be more completely exposed and studied.

ARTERIES OF THE INTRAPELVIC FEMALE GENERATIVE ORGANS.—This is a convenient stage to examine the uterine and vaginal arteries.

The *uterine artery* rises from the hypogastric or internal iliac artery close to or in common with the vesical and middle hæmorrhoidal arteries, after which it runs downwards and inwards through the pelvic cellular tissue and uterine plexus of veins (*parametrium*) to the cervix uteri, passing just above and in front of the ureter. Here it gives off a cervical branch, but the main artery runs a very tortuous course along the side of the body of the uterus between the folds of the broad ligament, in which it will be followed later (see Fig. 285).

The *Vaginal Artery* usually replaces the inferior vesical of the male and runs in the cellular tissue to the vagina, where it breaks up into numerous anterior and posterior branches, which again anastomose to form a very tortuous median branch running longitudinally in front and behind the vagina.

Both these arteries are accompanied by a plexus of veins.

EXAMINATION OF THE FEMALE PELVIC VISCERA

The viscera may now be removed and examined in detail, the peritoneum still adherent to them on the left side. The pelvic colon, rectum, and anal canal behind, and the bladder in front, are similar in all respects in the two sexes, and the student is referred to the description of these parts already given. The genital organs require, of course, special observation.

Remove in one piece the uterus, Fallopian tubes, ovaries, vagina, bladder, and urethra. The last two structures are included because it will be found that the urethra is closely

and firmly attached to the anterior wall of the vagina. Dissect away the loose cellular tissue from these organs, but leave any strong fibro-ligamentous cords which may be found.

The UTERUS will be seen to receive the two Fallopian tubes a little below its upper limit, the portion which lies above the level of the tubes being known as the *fundus*. Immediately below the tubes a fibrous cord, the *round ligament*, passes forwards from the anterior surface of the body of the uterus, while from the posterior surface, at the same level, a cord—the *ligament of the ovary*—passes outwards to the uterine pole of the ovary. At a still lower level, in the region of the cervix, but from the same posterior surface, there passes backwards on either side a similar fibrous cord, the *utero-sacral ligament*. It may be possible to distinguish in both the round ligament and in the utero-sacral ligament the presence of muscular fibres derivable from the uterine musculature. Certain muscular fibres may also be seen passing from the lateral border of the uterus outwards into the broad ligament, in consequence of which the uterus is not sharply limited at the side. The anterior and posterior surfaces of the uterus are, on the other hand, free, being merely covered by closely adherent peritoneum [perimetrium]. It will be noticed that the whole of the posterior surface of the uterus is covered by peritoneum, but only the upper two-thirds of the anterior surface. By this difference, by the forward direction of the round ligaments, as well as by the fact that, whereas the posterior surface is convex the anterior is flat, it is possible to distinguish the surfaces of the isolated uterus. The lower portion or *neck* of the uterus [cervix uteri] is divided into two parts, supra-vaginal and intra-vaginal, of which only the former can be seen at present. It may be noted here that the axis of the body of the uterus is not in the same line as that of the cervix, but forms with it an angle open in front; in other words, the body of the uterus is bent forward or anteflexed. Farther,

in addition to this bending, the whole uterus, body and cervix, is turned forwards from the coronal plane of the trunk into an oblique plane passing forwards and upwards, the position being known as that of anteversion. A proper understanding of anteflexion and anteversion is of considerable importance, since errors of position are far from uncommon.

The *Fallopian tubes* [tubæ uterinæ] will be seen to be about four or five inches in length. In addition to the fimbriated extremity, the following parts can be distinguished: a short narrow portion, the *isthmus*, which joins the uterus; a relatively wide portion, the *ampulla*, which forms the greater part of the tube; and a second constricted portion, the cervix, which adjoins the fimbriated end. The tubes pursue a somewhat wavy course from uterus to ovary, around which latter organ the fimbriæ are disposed, being particularly related to its antero-internal surface. If the fimbriæ are closely examined they may be seen to be scored by a deep longitudinal groove on their ovarian surfaces, which serves to conduct safely the ovum from the ovary to the Fallopian tube. If the fimbriæ are carefully separated with two pairs of forceps, a cavity known as the *infundibulum* will be opened up. At the bottom of this is a small but easily dilatable aperture, leading into the tube, known as the *ostium abdominale*. Attached to the fimbriated extremity of the tube there is often a small hydatid.

The ovary may now be examined more closely, and the gland should be compared with specimens of different ages in the post-mortem room whenever the opportunity arises. In old dissecting-room subjects it is usually atrophied and very hard from fibrous contraction. In girls below the age of puberty it is small and its surface is quite smooth, but during menstrual life it is large and its surface puckered by the scars of ruptured *Graafian follicles* [folliculi oophori vesiculosi]. If a section is made of such an ovary, the Graafian follicles may be seen in various sizes, the ripest attaining the size of a small pea.

During pregnancy the ruptured Graafian follicle forms a large yellow mass known as the *corpus luteum*.

Now stretch out the broad ligaments and hold them up to the light. The ovaries and Fallopian tubes now assume a horizontal position, which, it is very important to realise, is not their position during life.

If the observer is fortunate he may see a series of delicate tubules lying above the ovary and radiating like a fan from the outer (as it is now lying) part of the upper edge of that organ.

These tubules form the *Epoöphoron* and suggest the vasa efferentia in the male.

Sometimes a delicate, white, thread-like structure is seen joining the upper ends of the tubules just described, and lying parallel to and below the Fallopian tube. This is the remains of the Wolffian duct in the female, and its outer end is sometimes connected with a small hydatid. Occasionally, though rarely, this duct may be traced along the side of the uterus and vagina to the vestibule beyond the hymen. Occasionally, too, a few thread-like tubules are to be found lying between the ovary and uterus and above the ligament of the ovary. These, when present, are known as the *paroöphoron*, and correspond to the paradidymis or organ of Giralde's in the male.

The *Vagina* is a passage $3\frac{1}{2}$ inches long, its anterior wall pierced above by the cervix uteri. Its walls are formed of fibro-muscular tissue, lined by mucous membrane, the appearance of which has been noticed already (see p. 108). In transverse section the vagina appears as a slit with its anterior and posterior walls in contact, except near the orifice, where its section resembles an H.

The *Bladder* in the female is similar in its position and relations to that in the male, except that it is in relation behind to the uterus and vagina instead of to the vesiculæ seminales, vasa deferentia, and rectum.

The *Urethra* in the female is a short passage 1 to $1\frac{1}{2}$

inch in length, and lies very close to the anterior wall of the vagina.

Make a median incision through the inferior wall of the bladder, beginning at the apex or urachus, and continue the incision along the anterior wall of the urethra. On turning the lips of the incision aside a good view of the interior of the bladder and urethra will be obtained. The mucous membrane of the bladder presents the same features in the two sexes; that of the urethra in the female is thrown into a number of longitudinal folds, which account for its great dilatability. Numerous small mucous glands (glands of Littré) open into it.

Now carry the longitudinal incision through the posterior wall of the urethra and anterior wall of the vagina, thus allowing the intra-vaginal part of the cervix and os uteri to be examined more fully.

In a multiparous uterus the *os externum* is often very large, with thick patulous lips, which are sometimes scarred or puckered, though in old females the orifice often contracts again to the clean-cut transverse slit noticed already in the nulliparous uterus. It is therefore not always possible to tell by the appearance of the os whether a female has borne children or no.

A circular os is occasionally met with, but it is abnormal and is usually associated with dysmenorrhœa or painful menstruation.

Lay open the uterus by a longitudinal incision from in front, having first passed a probe or seeker into its interior. Draw apart the cut edges, and notice that the cavity is divided into two parts, the body above and the cervix below. The anterior and posterior walls are in contact, so that the cavity is only a potential one.

The lower part or cervical canal is fusiform and is slightly constricted where it joins the cavity of the body, forming the *os internum*. Its mucous membrane in the nullipara is thrown into a series of folds which resemble a cypress twig,

since there is a median longitudinal ridge from which oblique

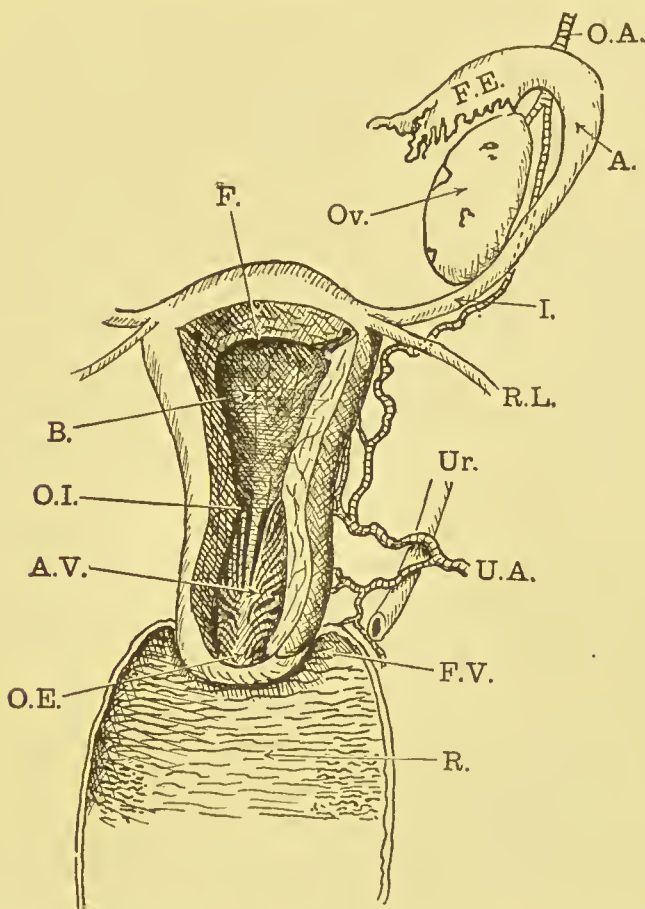


FIG. 286.—THE UTERUS AND APPENDAGES OF A WOMAN \AA T. 19 YEARS.
THE SPECIMEN HAS BEEN OPENED FROM IN FRONT.

F. Fundus. *B.* Body. *O.I.* Os Internum. *A.V.* Cervix showing the Arbor Vitæ arrangement of the Mucous Membrane. *O.E.* Os Externum. *R.* Vagina laid open to show the Rugæ. *F.V.* Lateral Fornix of Vagina. *U.A.* Uterine Artery. *Ur.* Ureter. *R.L.* Round Ligament. *I.* Isthmus of Fallopian Tube. *A.* Ampulla. *F.E.* Fimbriated Extremity. *O.A.* Ovarian Artery. *Ov.* Ovary.

ridges pass upwards and outwards. This, so-called, *arbor vitæ arrangement* [plicæ palmatæ] usually disappears after

the first pregnancy, and so is of considerable medico-legal importance.

Sometimes small cysts, caused by blocked glandular ducts [glandulæ cervicales], are found in the cervix and are known as *ovula Nabothi*.

The cavity of the uterine body is triangular with its apex below at the os internum; in the multiparous uterus it is rather longer than the cervical canal, though in nullipara the two are nearly of the same length. At the two upper angles the Fallopian tubes open, their orifices being known as the *ostia uterina*. In order to see one of these the Fallopian tube should be cut across close to the uterus and a bristle or very fine wire pushed along it; now cut away the anterior wall of the uterus until the ostium appears. Owing to its small size it is very difficult to find without the aid of a bristle. ,

Cut across the Fallopian tube again at its broadest part, and notice that the lumen is stellate because the mucous membrane is thrown into a series of longitudinal folds.

Now review the broad ligament once more on the left side; stretch it out, and notice that the Fallopian tube is the highest structure between its two layers. That part of the broad ligament which lies just below the tube is known as the *meso-salpinx*. The ovary projects backward and has its own reflexion of the broad ligament, called the *mesovarium*, while in front and below is the round ligament.

THE NERVES OF THE PELVIS

The best time to dissect the sacral plexus is after one side of the pelvis has been removed in order to gain enough room and light. To do this with as little injury to the joints as possible, saw through the body of the pubis on one side about half an inch from the symphysis.

On the same side saw through the ilium, from the crest

to the great sacro-sciatic foramen, a little in front of the sacro-iliac joint.

By using the knife carefully and by keeping a steady traction on the piece of bone thus freed, the latter may be removed with little injury to the vessels and nerves even on this side.

The obturator nerve and lumbo-sacral cord have been seen in the dissection of the arteries.

In revising the *obturator nerve* remember that it comes out of the inner and back part of the psoas and lies between that muscle and the external iliac vein, so that, in order to reach the nerve from the opened abdomen, the dissector should draw apart the psoas and external iliac artery, and then, more deeply, the psoas and external iliac vein.

Its closeness to the vein is responsible for the pink staining which is often so striking a characteristic of the obturator nerve.

The *Lumbo-sacral Cord* [truncus lumbo-sacralis] is easily found when the obturator has been located, since it lies a little deeper and a little nearer the mid line than that nerve.

The origin of the lumbo-sacral cord from the fourth and fifth lumbar nerves has been exposed already.

As the cord runs down it passes behind the common and internal iliac artery and vein and crosses in front of the sacro-iliac joint obliquely from above downwards and outwards. This is a relation of clinical importance, since the nerve may be affected in disease of this joint.

It is about this point that the *superior gluteal nerve* should be looked for, rising mainly from the lumbo-sacral cord with a smaller contribution from the first sacral nerve. It passes out of the pelvis through the upper part of the great sciatic notch lying just above the gluteal artery, which is here passing backwards between the lumbo-sacral cord and the first sacral nerve.

The first, second, third, and fourth sacral nerves are easily found coming out of the anterior sacral foramina and having

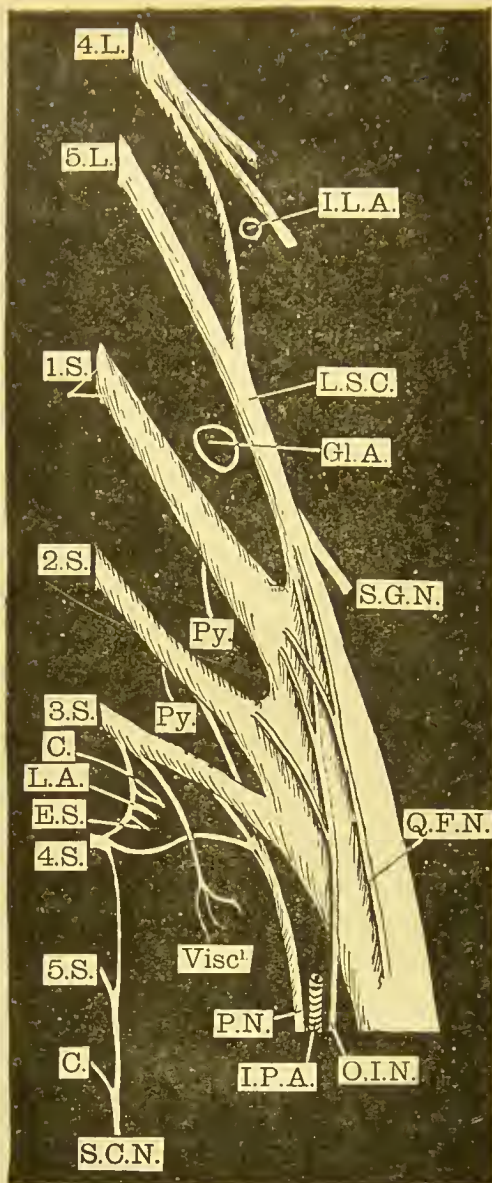


FIG. 287.—SACRAL PLEXUS FROM IN FRONT.

4 and 5 L., 1, 2, 3, 4, 5 S.C. Corresponding Lumbar, Sacral, and Coccygeal Nerves. I.L.A. Ilio-lumbar Artery. L.S.C. Lumbo-sacral Cord. Gl.A. Gluteal Artery. S.G.N. Superior Gluteal Nerve. Py. Branches to Pyriformis Muscle. Q.F.N. Nerve to Quadratus Femoris. O.I.N. Nerve to Obturator Internus. I.P.A. Internal Pudic Artery. P.N. Pudic Nerve. Visc^l. Visceral Nerve. C. (above L.A.) Nerve to Coccygeus. L.A. Nerve to Levator Ani. E.S. Nerve to External Sphincter. S.C.N. Sacro-coccygeal Nerve.

the slips of origin of the pyriformis between them. Each nerve communicates with the adjacent sympathetic ganglion by a grey ramus communicans. The white rami communicantes, although they are present from the second and third or third and fourth sacral nerves, do not pass through the sympathetic ganglia, but go direct to the pelvic plexuses. The first, second, and third sacral nerves, together with the lumbo-sacral cord, join to form the *great sciatic nerve* which passes out of the great sciatic notch in front of and below the pyriformis.

By careful dissection the *nerves to the obturator internus* and *quadratus femoris* may be found rising from the anterior surfaces of the nerves forming the great sciatic. The best way of finding them is to pull on the stumps left in the dissection of the gluteal region.

The fourth sacral nerve forms a loop with the lower part of the third sacral, from which *twigs to the levator ani, coccygeus, and external sphincter ani* may be traced with care, the latter nerve being followed through the coccygeus muscle and great sacro-sciatic ligament.

By dissecting carefully along the side of the lower part of the sacrum and coccyx the fifth sacral and the coccygeal nerve will be found; they join a branch of the fourth sacral, and supply the skin in the immediate neighbourhood of the coccyx as the *sacro-coccygeal nerve*.

So far the great sciatic, superior gluteal, and sacro-coccygeal nerves, as well as twigs to the obturator internus, quadratus femoris, levator ani, coccygeus, and external sphincter, are the branches found, but there are still the beginnings of the inferior gluteal, small sciatic, and pudic nerves to seek.

Find the cut ends of these, if possible, in the gluteal region, and notice that with the exception of the pudic they are superficial to (behind) the great sciatic. Their pelvic origins therefore are behind the great sciatic, and, in order to see them, either the great sciatic nerve should be pulled

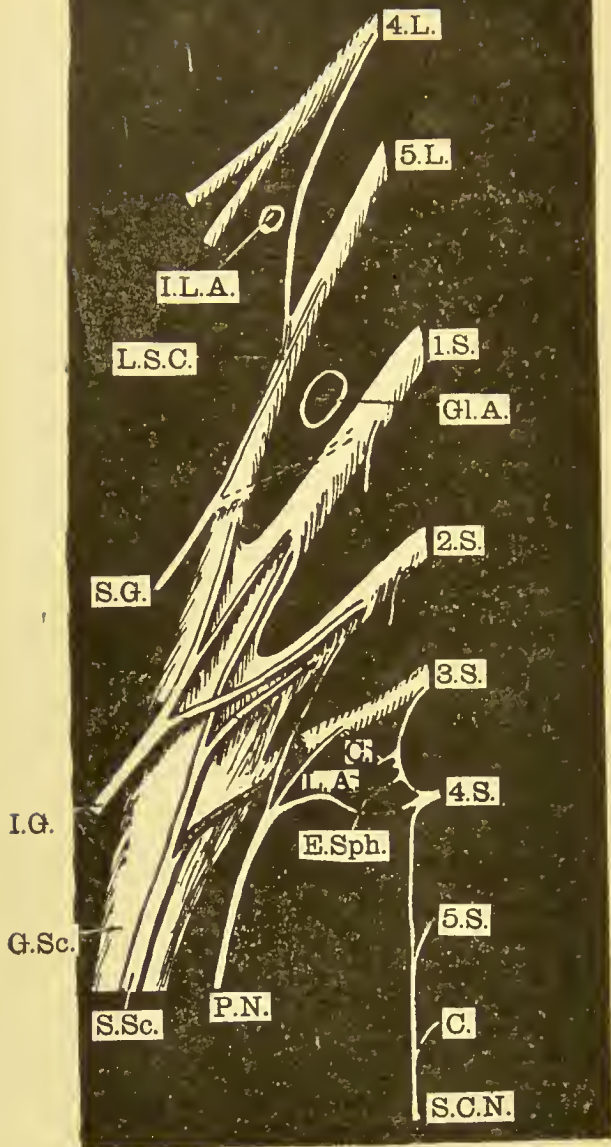


FIG. 288.—SACRAL PLEXUS FROM BEHIND.

4 and 5 *L.*, 1, 2, 3, 4, 5 *S.* and *C.* Corresponding Lumbar, Sacral, and Coccygeal Nerves. *I.L.A.* Ilio-lumbar Artery. *L.S.C.* Lumbo-sacral Cord. *Gl.A.* Gluteal Artery. *S.G.* Superior Gluteal Nerve. *I.G.* Inferior Gluteal Artery. *G.Sc.* Great Sciatic Nerve. *S.Sc.* Small Sciatic Nerve. *P.N.* Pudic Nerve. *E.Sph.* Nerve to External Sphincter. *L.A.* Nerve to Levator Ani. *C.* (above *L.A.*) Nerve to Coccygeus. *S.C.N.* Sacro-coccygeal Nerve.

inwards through the sacro-sciatic foramen so that its posterior surface may be seen, or the pyriformis cut away and the back of the plexus dissected through the foramen. Now the nerves in question will be visible, and the *inferior gluteal nerve* may usually be traced to the lumbo-sacral cord, first and second sacral nerves, the *small sciatic* to the first, second, and third, and the *pubic* [n. pudendus] to the second, third, and fourth.

The *perforating cutaneous nerve* is not always present, but when it is it will be found piercing the great sacro-sciatic ligament, and may be traced to the second and third sacral nerves.

It is usual to speak of the small sciatic, pudic, perforating cutaneous, muscular to the pelvic floor and visceral nerves (white rami communicantes from 2 and 3 or 3 and 4 sacral nerves) as constituting a plexus subsidiary to the sacral and known as the *Pudendal Plexus*.

LIGAMENTS AND ARTICULATIONS OF THE PELVIS

When everything else has been dissected, put what is left of the pelvis into a vessel of water for a night, and then clean away all the soft parts except the ligaments.

The *Sacro-iliac joint* has anterior and posterior ligaments, though their real positions in the upright body would be more accurately described as inferior and superior.

The anterior ligament is thin, being in striking contrast with the posterior, which is both thick and strong, and spreads itself over the bones at some distance from the articular surfaces.

In order to appreciate the importance of these posterior sacro-iliac ligaments, it must be realised that they play the part of the chains in a suspension bridge, slinging the sacrum, which represents the bridge, from the upright piers or ilia. Passing from the transverse process of the 5th lumbar vertebra downwards to the front of the sacro-iliac capsule is

a fan-shaped mass of fibres constituting the *Lumbo-sacral ligament*, while passing almost directly outwards from the same bony point to the inner lip of the iliac crest, at its point of greatest inward convexity, are the fibres of the *Ilio-lumbar ligament*.

The *Symphysis pubis* is surrounded by fibres on all sides, forming the anterior, posterior, superior, and inferior ligaments; the last, which is usually called the sub-pubic, extends on either side some distance along the pubic arch to end in a falciform edge.

The *Obturator membrane* fills the whole of the obturator foramen, except its upper and inner corner, where a small aperture is left for the obturator vessels and nerve. The membrane below is not attached to the margin of the obturator foramen, but to the inner surface of the pubic arch immediately below the margin.

The *Sacro-sciatic ligaments* are attached to the sides and part of the posterior surface of the sacrum and coccyx; their ischiatic attachments have been already noticed (p. 99).

The *Anterior Sacro-coccygeal ligament* is merely the downward continuation of the anterior common ligament; in cleaning it a few muscular slips may be met, the degenerate remains of a *curvator coccygis* muscle.

The *Posterior Sacro-coccygeal ligament* is more important, since it roofs over the lower part of the neural canal, and is pierced by the posterior primary divisions of the 4th and 5th sacral and coccygeal nerves as well as by the *filum terminale*.

The sacro-iliae and symphysial joints should now be studied by sawing transverse sections through them. The synovial cavity of the former is a mere cleft, and even that frequently more or less obliterated by the passage of fibres across it. The articular surfaces of the sacrum and ilium show a good deal of reciprocal moulding, rounded eminences on the one fitting into concavities on the other. Farther, a very strong, distinct, and sharp ridge limits the articular surface of the ilium anteriorly, and is a strong factor in the prevention of

forward dislocation of the sacrum. Notice, too, the obliquity of the joint as seen in transverse section; anteriorly, or, more correctly speaking, below, in the erect position of the body, the sacrum extends much farther outwards than it does behind (dorsally). Both the sacro-iliac joints and the symphysis pubis are true symphyses; that is, they have a layer of cartilage on both bony surfaces connected by intervening fibrous tissue. Occasionally synovial spaces occur in both joints, but they are small and inconstant, and hardly entitle these to rank with the arthrodia or gliding articulations, which are the next higher stage in the classification of joints.

The joints between the last lumbar vertebra and the sacrum are in series with those between the other vertebræ, and only noteworthy on account of the wedge-shape of the intervertebral disc, the base of the wedge being anterior and the edge posterior.

In addition to the sacro-coccygeal ligaments already mentioned, some strong ligamentous fibres pass between the superior cornua of the coccyx and the inferior cornua of the sacrum—the *interarticular sacro-coccygeal ligament*—and also fibres between the transverse process of the first coccygeal vertebra and the lateral angle of the sacrum—the *lateral sacro-coccygeal ligament*.

THE UPPER EXTREMITY

DISSECTION OF THE SUPERFICIAL LAYERS OF THE BACK

It is usually found a convenient arrangement to allot to the dissector of the upper extremity the muscles which attach that extremity to the trunk together with the vessels and nerves supplying them.

As the body is now generally placed for the first week on its face, the first thing the dissector must do, after carefully wrapping up the limb, is to identify the surface markings on the back of the trunk.

SURFACE MARKINGS OF THE BACK OF THE TRUNK

In the mid line feel the spines of the vertebræ. The first thoracic is usually the most obvious of these, both to the finger and the eye, while above it the seventh cervical is nearly as distinct. Above these the cervical spines are far from the surface, and no bony point is felt until the external occipital protuberance is reached, from the sides of which the superior curved line runs outwards towards the mastoid process.

The spines below the first thoracic become less and less distinct until the lumbar region is reached, where they lie in a hollow between the erector spinæ muscles of the two sides.

A good deal of the outline of the scapula is visible: the vertebral border, especially if the arms are hanging down over the edges of the table, is very distinct and ends at the upper and lower angles.

When the arms are lying by the side of the body the

lower angles of the scapulæ are on a level with the spine of the seventh thoracic vertebra, while the spine of the scapula is easily localised, starting from its root at the vertebral border and running upwards and outwards to the acromial process. On running the finger along the lower border of the spine, and so along the lower and outer margin of the acromion, about an inch from the tip of the acromion, a fairly definite tubercle is felt, which is known as the *metacromial process*, and is a very useful point from which to take measurements of the arm.

Working the finger round the tip of the acromion the clavicle will be felt, and the *acromio-clavicular joint* localised by a slight depression. If there is the slightest difficulty in finding this, move the arm freely in any direction and it will become apparent.

Nothing can be felt of the *shoulder joint* from behind, since it is covered by two layers of thick muscle; its position, however, is about a finger's-breadth internal to the metacromial process.

In the lower part of the trunk the crest of the ilium must be defined even by the dissector of the upper extremity. In the living body there is usually a dimple in the skin corresponding to the posterior superior spine, and from this the crest runs upwards and outwards. A line joining the highest points of the two crests passes through the fourth lumbar spine.

Skin incisions.—Make one long incision right down the mid dorsal line, in the spinal furrow, from the external occipital protuberance to the sacrum. From the top of this make another at right angles for one inch outwards, along the superior curved line of the occipital bone.

From the bottom of it make a curved incision along the crest of the ilium as far as its middle.

A fourth incision should be started at the tip of the acromial process, and should run downwards and inwards along the spine of the scapula as far as its root, and

then should be prolonged until it meets the long median incision.

It will be found that the skin of the back is very thick, but experience as to this may be cheaply bought in the mid line, where there is nothing to be injured by too deep an incision.

Reflect the flaps outwards, and look out for the *cutaneous branches of the posterior primary divisions of the spinal nerves*.

The third thoracic is the largest of these, and runs out towards the acromial process. No words can teach a student to recognise a small nerve as it lies embedded in its surrounding connective tissue, yet with a little experience these structures are recognised quickly enough.

It is best to hunt for cutaneous nerves where they are first becoming cutaneous, and to remember that here they are often accompanied by small arteries and veins, and are of a dead, creamy-white colour, while fibrous strands are of a bluish-white tint.

Bear this in mind, and clean away the cellular tissue near the third thoracic spine until the surface of the trapezius is reached. Let each cut be clean and definite, and carefully examine each structure about to be cut through before actually dividing it. About an inch outside this spine look especially carefully, and the nerve will almost certainly be seen coming through the fibres of the trapezius muscle. Once seen it should be gently picked up with the forceps, and followed as far as the dissector's skill permits. Opposite each vertebral spine, with the exception of the lower cervicals, one of the posterior primary branches of the spinal nerves will be found; but as the lower part of the trunk is approached, the branches come to the surface farther away from the mid line, because each posterior primary division divides into external and internal branches, and in the upper six thoracic nerves the internal branch becomes cutaneous, while in the lower six, or thereabouts,

it is the external branch which supplies the skin. The external branches of the posterior divisions of the upper

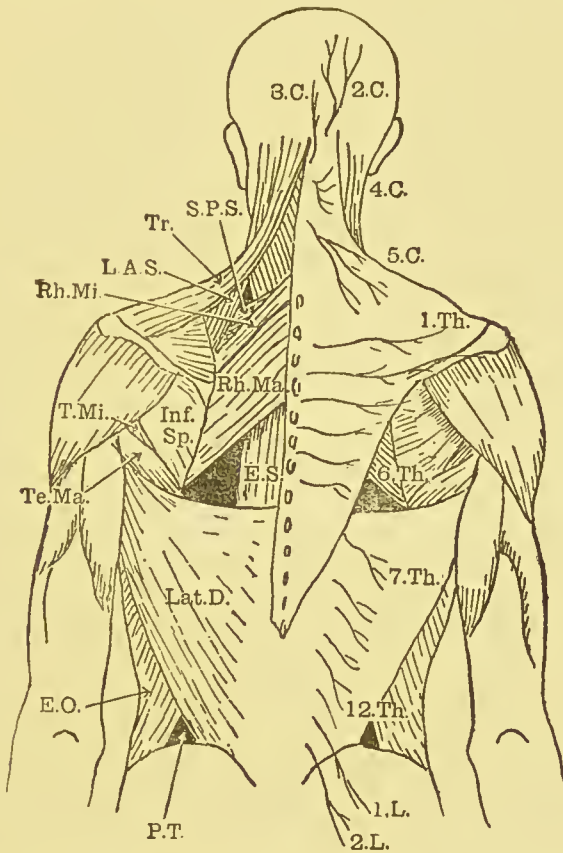


FIG. 289.—DISSECTION OF THE SUPERFICIAL MUSCLES AND NERVES OF THE BACK.

2, 3, 4, 5 *C.* Cervical Nerves. 1, 6, 7, 12 *Th.* Thoracic Nerves. 1, 2 *L.* Lumbar Nerves. *S.P.S.* Serratus Posticus Superior. *Tr.* Trapezius. *L.A.S.* Levator Anguli Scapulæ. *Rh.Mi.* Rhomboideus Minor. *Rh.Ma.* Rhomboideus Major. *Inf.Sp.* Infraspinaus. *T.Mi.* Teres Minor. *Te.Ma.* Teres Major. *E.S.* Erector Spinæ. *Lat.D.* Latissimus Dorsi. *E.O.* External Oblique. *P.T.* Petit's Triangle.

three lumbar nerves become cutaneous at the outer edge of the erector spinæ muscle, which forms the rounded mass lying on each side of the median spinal furrow, and run

obliquely downwards and outwards superficial to the crest of the ilium, where they should be handed over to the dissectors of the lower extremity (see Fig. 289).

When all these nerves have been dissected out as far as possible, they may be turned towards the middle line, and the *trapezius muscle* defined.

This muscle will be found rising from the external occipital protuberance and a small adjacent part of the superior curved line of the occipital bone, from the *ligamentum nuchæ*, which stretches from the occipital protuberance to the tip of the seventh cervical spine, and then from all the thoracic spines and the supraspinous ligament which joins their tips. The upper fibres run down and out to the outer third of the clavicle, but the outer border of the cervical part of the muscle should not be interfered with, because it is an important landmark in the neck. The fibres from the upper thoracic spines run horizontally outwards to the upper border of the spine and acromial process of the scapula, while the lower ones run upwards and outwards, and form a short, flat, triangular tendon, which is inserted into the root of the scapular spine. Opposite the upper three thoracic spines there is a small patch of tendon, which, with its fellow of the opposite side, has a diamond shape. Except for this, and the triangular patch at the root of the scapular spine, already mentioned, the trapezius is entirely fleshy.

Clean the muscle, being especially careful to define its lower and outer border, and to get at the same time a good idea of the direction of its fibres.

Now reflect the trapezius outwards by cutting through it about an inch away from the mid line, only do not take the incision to the upper and outer border of the muscle, which must be kept intact for the dissectors of the neck.

Be careful not to cut through more than the trapezius; this cannot very well happen if the lower and outer edge has

been clearly enough defined to allow a finger to be pushed up deep to the muscle for some little way.

As the upper part of the vertebral border of the scapula is approached, keep a look-out for the *spinal accessory nerve* [n. accessorius] on the deep aspect of the muscle; this has either already received communicating branches from the third and fourth cervical nerves or is joining and forming a plexus with them. Some branches of the superficial cervical artery accompany the nerves.

The *latissimus dorsi* must next be defined; its origin from the lower six thoracic spines and supraspinous ligaments is evident now that the trapezius is reflected; below this it rises from a glistening aponeurosis known as the *lumbar fascia* [f. lumbo-dorsalis], which transmits its pull to the lumbar and sacral spines. Beyond the outer limit of the lumbar fascia, the *latissimus dorsi* rises for about an inch from the outer lip of the iliac crest a little behind its middle.

This origin is continued up as the outer and lower margin of the muscle, and, close to the iliac crest, forms the inner boundary of *Petit's triangle* [trigonum lumbale], which, like the lumbar fascia, interests the dissectors of the abdomen more than those of the upper extremity. The upper edge of the muscle needs defining very carefully, and in doing this it will be noticed that it lies superficial to the lower angle of the scapula, sometimes gaining a slip of origin from that place. External to the scapula the *latissimus dorsi* lies behind (superficial to) part of the *teres major*, a muscle which is easily distinguished lying just above the *latissimus dorsi*, and rising from the lower angle of the scapula, but as the axilla is approached the *latissimus* narrows rapidly, and becomes gradually wrapped round the lower border of the *teres major*. Cut the muscle across a little external to the angle of the scapula, and turn back the broad end; it will then be seen to take origin from the last three ribs by fleshy bundles interdigitating with the origin of the external oblique muscle.

The trapezius and latissimus dorsi form the first layer of back muscles. Replace them carefully, and notice how the lower and outer border of the trapezius crosses and then runs away from the upper border of the latissimus dorsi, enclosing a triangular space, the base of which is the posterior border of the deltoid, and the origin of the triceps below it. This space should be cleaned carefully, and then it will be seen that at its apex, where the two muscles diverge, there is a smaller and deeper triangle, the floor of which is formed by a rib or part of an intercostal space (see Fig. 290).

At this point, then, the coverings of the chest are deficient, and intra-thoracic sounds are heard here with the stethoscope more clearly than elsewhere during life. It will be noticed that this uncovered area lies a little above and to the inner side of the lower angle of the scapula.

In passing from the apex towards the base of the triangle formed by the trapezius and latissimus dorsi, the next thing noticeable in the floor is the lower margin of the rhomboideus major, outside which the infraspinatus and teres major form the floor, concealing the scapula.

The trapezius and latissimus dorsi should now be reflected once more, and the muscles of the second layer studied; these are the levator anguli scapulæ and the two rhomboid muscles.

The *levator anguli scapulæ* [m. levator scapulæ] rises from some of the cervical transverse processes, and its origin should not be interfered with by the dissector of the upper extremity. Its insertion, however, into the vertebral border of the scapula, above the root of the spine, should be carefully noted. Do not cut it until the arm is actually ready for removal, since it is of importance to the dissectors of the neck.

On each side of the levator anguli scapulæ some structures should be found which it will be well to point out to the head and neck dissectors.

On the outer side of the insertion of the muscle feel care-

fully with the finger for the upper border of the scapula, which is overlapped by the supraspinatus muscle. Have a

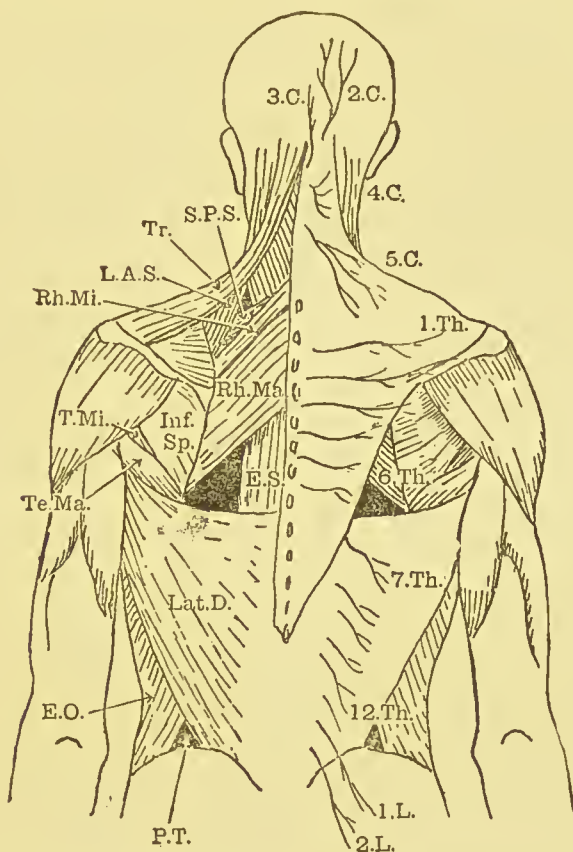


FIG 290.—DISSECTION OF THE SUPERFICIAL MUSCLES AND NERVES OF THE BACK.

2, 3, 4, 5 *C.* Cervical Nerves. 1, 6, 7, 12 *Th.* Thoracic Nerves. 1, 2 *L.* Lumbar Nerves. *S.P.S.* Serratus Posticus Superior. *Tr.* Trapezius. *L.A.S.* Levator Anguli Scapulae. *Rh.Mi.* Rhomboidens Minor. *Rh.Ma.* Rhomboidens Major. *Inf.Sp.* Infraspinatus. *T.Mi.* Teres Minor. *Te.Ma.* Teres Major. *E.S.* Erector Spinae. *Lat.D.* Latissimus Dorsi. *E.O.* External Oblique. *P.T.* Petit's Triangle.

dry scapula of the same side for reference, and follow the border outwards until the region of the suprascapular notch is reached. Just before this is reached the posterior belly of

the *omo-hyoid* muscle is attached to the border and runs upwards, inwards, and forwards from its attachment. With a little deep dissection a sight of it will be gained, but it is not advisable to do more than realise that the back of the muscle can be exposed from this point of view.

Accompanying the posterior belly of the *omo-hyoid* are the *suprascapular artery* [a. transversa scapulæ] and *nerve*; these will be exposed in the posterior triangle when the neck is dissected, but here they are seen as they are turning back over or through the suprascapular notch. Notice that the nerve is lower than the artery and passes through the notch, while the artery lies above the transverse ligament which converts the notch into a foramen.

On the inner side of the insertion of the levator anguli scapulæ in the angle between it and the rhomboideus minor, look for the *posterior scapular artery and nerve to the rhomboids*.

Only a glimpse of them will be caught in the small interval between the levator anguli scapulæ and the rhomboideus minor. When the artery is seen, the nerve should be looked for nearer the mid line of the body.

Now examine the *rhomboideus minor*, which rises from the seventh cervical and first thoracic spines, and is inserted into the vertebral border of the scapula opposite the root of the spine. Cut it to verify its attachments, but, in reflecting it, look very carefully for its little twig from the nerve to the rhomboids which enters its deep surface.

The *rhomboideus major* rises from the spines of the second to the fifth thoracic vertebræ or thereabout as well as from the supraspinous ligament; it may be mentioned here that this ligamentous origin is an important one to remember, because but for it these flat muscles would have to arise from the spines by a series of digitations which would give quite a different appearance to the part. The insertion is into the vertebral border of the scapula, below the root of the spine, by a tendinous arch which is better seen when the muscle is

out through and reflected, because a few of the superficial fibres often reach the vertebral border in its whole extent. In reflecting the muscle define the termination of the nerve to the rhomboids, the greater part of which enters the muscle close to its upper border.

It will be noticed that the fibrous arch is much more strongly attached below, and the part it plays is rather a neat little bit of mechanism for concentrating the action of a broad flat muscle on one point; because, since the fibres of the rhomboideus major run downwards as well as outwards, they pull much more strongly on the lower attachment of the arch, and so make the muscle act on the lower angle of the scapula where there is most leverage.

Now replace all the divided muscles, none of which has been damaged, and if it has not already been done, the student is strongly advised to sketch the first and second layers separately, putting in the arteries and nerves in colour. Notice that the only parts of the second layer which are not concealed by the first are the upper part of the levator anguli scapulæ, which is in the neck and does not concern us here, and the lower angle of the rhomboideus major. The whole of this dissection should not take more than two days, and for the next two or three days the body must be left to the other dissectors. The interval may be well spent in learning and drawing the bones of the upper extremity.

THE PECTORAL REGION

SUPERFICIAL LANDMARKS

Notice the suprasternal notch, above the manubrium, between the inner ends of the two clavicles, and then run the finger down the mid line until the junction between the pre- and meso-sternum (manubrium and gladiolus) is reached. This is easily felt as a definite transverse ridge, and corre-

sponds to the junction of the two second ribs with the sternum.

On reaching the lower end of the meso-sternum (gladiolus) the meta-sternum or ensiform cartilage is felt on a deeper plane between the sternal ends of the seventh costal cartilages.

Now feel the clavicle along its whole length, first with the index finger and then with the finger and thumb, and compare it with a dry bone of the same side. Notice how much the inner end projects above the sternum; then trace the forward convexity of its inner and the forward concavity of its outer part. Place the arm comfortably by the side, and notice that the bone is nearly if not quite horizontal. Push the shoulder up and down, and see the range of movement of the clavicle, and what a difference the position of the bone will make to the relations of the soft structures behind it.

Feel the pectoralis major rising from its inner half and the deltoid rising from its outer third, leaving a little triangle with its apex downwards between them. This is the *infraclavicular triangle* or *fossa*, and just behind its outer edge, that is to say, behind the inner edge of the deltoid, one inch below the junction of the middle and outer thirds of the clavicle, the tip of the coracoid process will be felt on deep pressure. Look at the dry scapula, and notice that the tip of this process lies just internal to the upper part of the shoulder joint. In a thin subject the lesser tuberosity of the humerus may be felt easily enough external to the tip of the coracoid process. On slightly rotating the arm it will move, while the coracoid is steady.

The great tuberosity is responsible for the outward convexity of the deltoid. When the shoulder is dislocated and the tuberosity no longer in its proper place, the flattening of the deltoid is quite characteristic.

The lower border of the pectoralis major is easily felt and seen, especially if the arm be abducted; it forms the rounded

anterior fold of the axilla, while the posterior fold is caused by the *teres major* and *latissimus dorsi* muscles.

Running downwards into the arm from under cover of the anterior axillary fold is the rounded (transversely convex) eminence of the *coraco-brachialis* muscle, and just behind this, in a slight furrow, lies the end of the axillary artery.

The lower border of the *pectoralis major* leaves the chest at the level of the fifth rib, and a little above it is the *nipple*. This generally overlies the fourth rib or fourth intercostal space, but in old females is very variable. Measure its distance from the middle line, and note that it is about four inches.

A well-developed *female breast* is seldom seen in the dissecting-room, but in the post-mortem room it will be seen as a flattened cone the circular base of which overlies the *pectoralis major* for two-thirds of its extent, though the lower and outer third covers the *serratus magnus*. On the summit of the nipple the minute openings of the lactiferous ducts may just be seen, while surrounding it is a pink or pigmented circular patch, the *areola*. During pregnancy the pigmentation of the areola and nipple increases. Surrounding the female nipple a ring of nodular *areolar glands* should be looked for.

When the arm is lifted up (abducted) five serrations of the *serratus magnus* are seen in thin muscular subjects rising from the ribs below the border of the *pectoralis major*. Now push the fingers well up into the axilla and rotate the arm with the other hand, at the same time abducting and adducting it; this should enable the lower part of the head of the humerus to be felt just below the glenoid cavity. Here, perhaps, it will be well to clearly understand the various movements of the shoulder joint.

When the arm is drawn away from the side the movement is called abduction, though at the shoulder joint it is only possible to abduct till the arm forms a right angle with

the body; when the arm is raised higher, it will be felt that the movement is due to rotation of the scapula. Adduction is the opposite of abduction. Flexion of the shoulder is when the arm is brought forward, and, like abduction, is only possible for a quarter of a circle at the shoulder joint.

Extension is the opposite of flexion, but is not so free, since the scapula begins to move long before the arm has gone back through ninety degrees from the vertical position of rest. External rotation is the action produced by twisting the arm in such a way that the lesser tuberosity of the humerus moves outwards while the reverse movement is internal rotation.

SKIN INCISIONS

(1) Make a median vertical incision from the suprasternal notch to the xiphoid or ensiform cartilage.

(2) From the top of this incision make a horizontal one along the clavicle until the acromion is reached, but be careful not to go deeper than the skin.

(3) From the outer end of this make a vertical incision down the outer side of the shoulder until the lower part of the deltoid convexity is reached, *i.e.* for three or four inches.

(4) From the lower end of incision number three cut horizontally inwards across the long axis of the arm to a point a little below the anterior fold of the axilla. This incision must be very carefully made, and should merely expose the subcutaneous fat.

(5) From the lower end of number one make a horizontal incision outwards as far as the mid-axillary line, *i.e.* a line dropped vertically from the middle of the axilla when the body is in the erect position.

Never forget that in all descriptions the body is assumed to be in the "anatomical position," that is to say, standing upright, with the arms by the side and the palms turned forwards.

Reflect the large flap, thus marked out, downwards and outwards, when the pectoral region and lower part of the axilla will be exposed.

SUPERFICIAL STRUCTURES

The upper part of the chest is supplied by the superficial descending branches of the cervical plexus; these are in three sets, all of which pass superficial to the clavicle, and are most easily found as they are crossing it. The largest of the three is the *supra-acromial*, which should be looked for over the outer third of the clavicle; once found, its twigs may be traced down to the level of the middle of the deltoid.

The *supra-clavicular* should be picked up over the middle of the clavicle, while the *supra-sternal* branch is the smallest and is often represented by some of the inner twigs of the last; it winds round the outer edge of the sterno-mastoid muscle, and crosses the inner end of the clavicle close to the sterno-clavicular articulation. In exposing these nerves the lower fibres of the thin subcutaneous *platysma* muscle will have to be cleared away.

Now dissect away the superficial fascia covering the origin of the pectoralis major close to the outer edge of the sternum, and look very carefully in each intercostal space for the *anterior cutaneous branches of the intercostal nerves*. Their position is indicated by the small *perforating branches of the internal mammary artery* which accompany them. In the female it will be noticed that they supply the median part of the mammary gland.

The *lateral cutaneous branches of the intercostal nerves* must be looked for near a line running down from the middle of the axilla, but before looking for them the arm should be abducted and fastened out on a board.

Before piercing the muscle they divide into anterior and posterior branches, which supply the skin of the side of the

trunk, while the anterior branches also innervate the lateral part of the mammary gland.

It is best to secure the nerve in the fourth intercostal space first, and then to work downwards; afterwards, by continuing the line up into the dense cellular tissue of the axilla, the third and second branches may be found. The lateral cutaneous branch of the second intercostal nerve often wants an anterior division, but the posterior division is very large and runs across the axilla to the inner side of the arm;

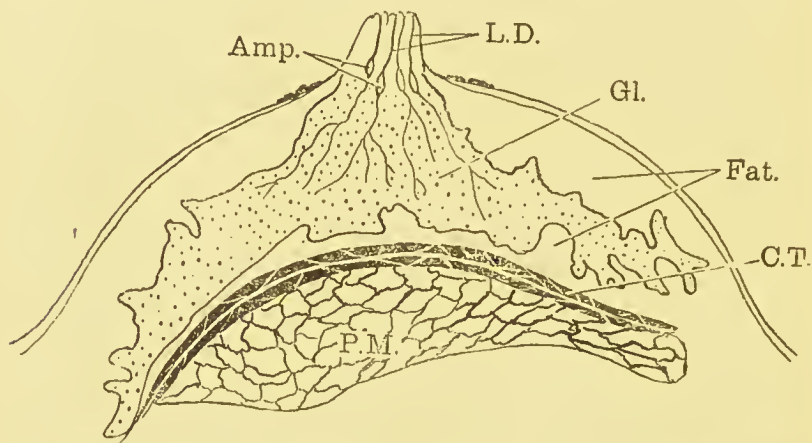


FIG. 291 —SECTION OF THE BREAST OF A WOMAN 7 MONTHS PREGNANT. (TRACED WITH A DIAGRAPH.)

L.D. Lactiferous Ducts. *Amp.* Ampullae. *Gl.* Mammary Gland. *P.M.* Pectoralis Major. *C.T.* Compressed Cellular Tissue looking like a Sheet of Fascia.

it is known as the *intercosto-humeral nerve* [n. intercosto-brachialis], and should not be followed into the arm at present. The posterior branch of the third lateral cutaneous nerve has often a similar distribution, and may join the second. Notice how easily these nerves might be cut in incising the axilla during life, though the result would only be a slight loss of sensation (anæsthesia) of the inner side of the arm.

The *mammary gland* is usually atrophied in the female subjects found in the dissecting-room. In the rare cases in

which it is normally developed it should be examined with great care, because it is such a frequent site of cancer and other troubles.

Make a transverse cut right through it, passing through the nipple and reaching down to the subjacent pectoralis major muscle. Notice that the glandular tissue fades very gradually into the surrounding fat, and the two can only be distinguished with great care. On the convex superficial surface pyramidal processes of glandular tissue approach the

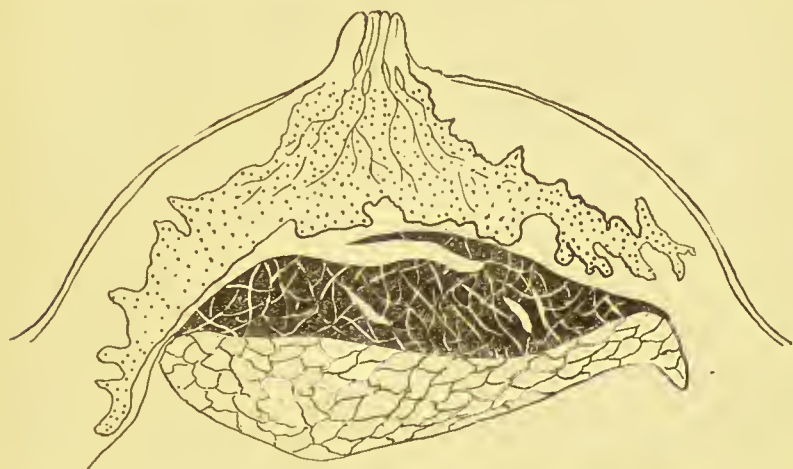


FIG 292.—THE SAME SECTION AS THAT SHOWN IN FIG. 291 AFTER THE BREAST HAS BEEN DRAWN AWAY FROM THE PECTORAL MUSCLE TO SHOW THE CELLULAR TISSUE BETWEEN THEM.

skin here and there, while the intervals between them are filled with fat, giving the skin over the gland its even contour. On its concave deep surface the gland is only separated from the pectoralis major by a thin bed of cellular tissue containing a little fat. On gently drawing the breast away from the pectoral muscle it will be seen that there is no definite sheet of fascia, though, if the gland is dissected away, the cellular tissue will at once condense into an artificial sheet. In certain places minute processes of the gland are said to push their way through the cellular bed, and follow the fibrous

tissue between the distinct muscular bundles of the pectoralis major. This, however, is an observation which the author has never been able to verify.

In its lower and outer third, where the breast lies on the serratus magnus, there is a much thicker and more fatty bed. A section through this part of the gland should be made to prove the statement.

In the nipple and areola there is no subcutaneous fat. Try to recognise in the nipple some of the *lactiferous ducts*, and follow them towards the substance of the gland. Below the base of the nipple each dilates into a little fusiform reservoir called the *ampulla*.

Owing to the way in which the glandular tissue is embedded in fat, it is difficult to demonstrate the fifteen to twenty lobes of which it is formed, but a very serious attempt should be made to localise the margins of the organ.

In the horizontal section it will be seen to reach the edge of the sternum medially, while laterally it reaches beyond the anterior axillary fold, sending a process called the *axillary tail* upwards and outwards into the axilla. Now make a vertical section through the gland, and notice that it extends in this direction from the second to the sixth ribs.

THE DEEP PECTORAL REGION AND AXILLA

The student who is dissecting the arm for the second time, or who has gained considerable skill in the art of dissecting and of recognising various structures, may now dissect the axilla from below, thus gaining an idea of the relations and to some extent the appearance of the parts as they are in the living body. For the beginner, however, experience teaches that this is not advisable, since the dissection has to be carried on in a cramped space and with little light. It is far better to reflect the pectoral muscles, turning them aside and replacing them from time to time so as to restore the original boundaries of the axilla. First cut the clavicular

origin of the pectoralis major close to the clavicle and turn it down. On lifting it a mass of loose cellular tissue containing fat in its meshes is seen attached closely to the muscle. As this is dissected off it collapses into a sheet called the *costo-coracoid membrane*, a structure which is largely artificial, and has been much more elaborately described than it deserves.

Occasionally this cellular tissue is thickened into a definite band, where it stretches from the first rib across to the coracoid process, and to this thickening the name of *costo-coracoid ligament* has been given.

As the strip of muscle is gradually reflected to its insertion into the outer lip of the bicipital groove, the external anterior thoracic nerve, as well as some branches of the acromio-thoracic artery, will be seen to enter its deep surface.

It will be seen, too, that the clavicular slip of the pectoralis major lies superficial (anterior) to the rest of the muscle at its insertion, and, although it is the highest part of the muscle at its origin, it is the lowest at its insertion.

Cut through the rest of the pectoralis major a little distance from the edge of the sternum and turn it outwards, freeing it from the subjacent cellular tissue, and looking carefully for further branches of the external anterior thoracic nerve as well as the internal anterior thoracic [nn. thoracales anteriores], both of which supply it.

On reflecting what is left of the origin of the muscle, it will be seen to arise from its own half of the front of the sternum, from the cartilages of the upper six ribs and from the aponeurosis of the external oblique muscle of the abdomen.

At the lower border of the muscle the fibres coming from the aponeurosis of the external oblique are seen to wrap round deep to those rising from the sternum, thus forming the thickened edge of the anterior fold of the axilla. Often this wrapping is so distinct that at the insertion into the outer lip of the bicipital groove the whole muscle is distinctly trilaminar, the superficial layer being the clavicular fibres,

the intermediate those coming from the sternum, while the deepest is the abdominal part.

Instead of cutting the nerves which enter it, a small mass of the muscle may be cut out and left attached to them. Now identify the *pectoralis minor*, rising from the bony parts of the second, third, fourth, and perhaps the fifth ribs, and converging to a small tendon which is inserted into the anterior border of the coracoid process, and also blends with the origin of the coraco-brachialis.

This muscle lies embedded in the cellular tissue of the axilla, and the *internal anterior thoracic nerve* should be looked for piercing its fleshy fibres. Now dissect away the cellular tissue between the upper border of the *pectoralis minor* and the clavicle. This is the orthodox costo-coracoid membrane, though membrane is not a happy term to describe it in the undissected state. Three structures pierce this cellular tissue and must be preserved; they are (1) the *acromio-thoracic artery* [A. thoraco-acromialis], which gives off thoracic, acromial, clavicular, and humeral twigs; (2) the *cephalic vein*, dipping in from the groove between the *pectoralis major* and deltoid, and accompanying the humeral branch of the last-named artery. This usually receives the veins accompanying the branches of the acromio-thoracic artery; (3) the *external anterior thoracic nerve*. Follow the cephalic vein carefully, and it will lead to the axillary vein, into which it opens.

Follow the acromio-thoracic artery, and it will lead to the first part of the axillary artery, which is here to the outer side of and behind the axillary vein.

Follow the nerve and it will lead to the outer cord of the brachial plexus, which lies on the outer side of the axillary artery. In dissecting these three structures keep a sharp look-out for lymphatic nodes, a group of which lies close to the opening of the cephalic vein, and is known as the *infra-clavicular group*.

Just below the clavicle the *subclavius muscle* must be

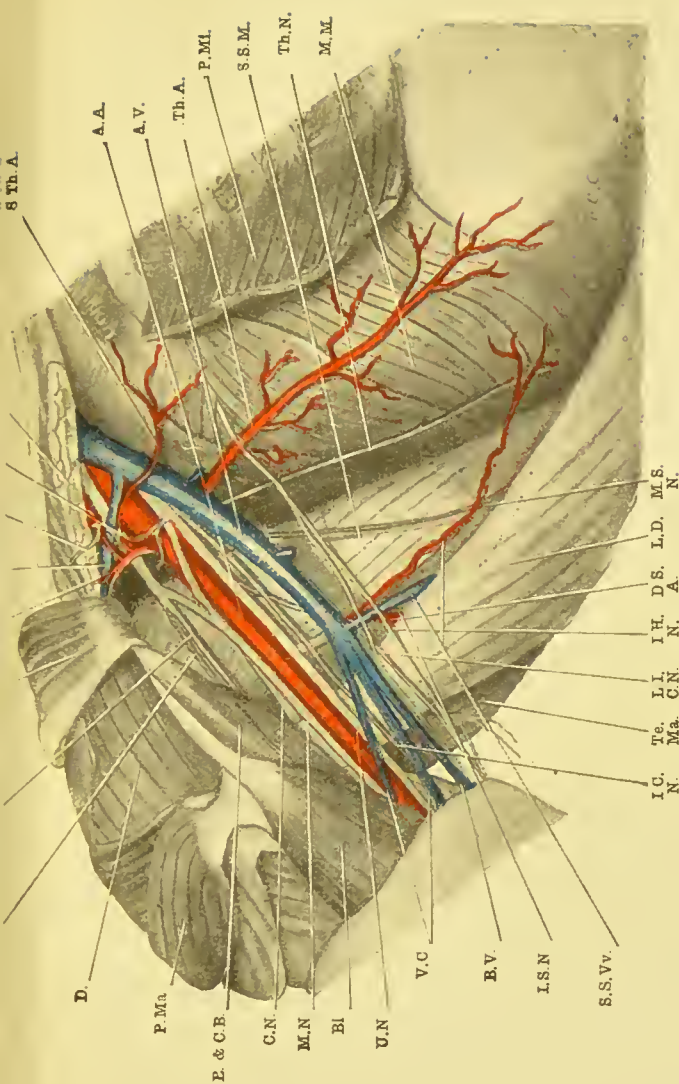


FIG. 293.—DISSECTION OF THE AXILLA.

P.Mi. Pectoralis Minor. *A.T.A.* Acromio-thoracic Artery. *C.V.* Cephalic Vein. *E.A.T.N.* External Anterior Thoracic Nerve. *I.A.T.N.* Internal Anterior Thoracic Nerve. *P.Ma.* Pectoralis Major. *S.Th.A.* Superior Thoracic Artery. *A.A.* Axillary Artery. *A.V.* Axillary Vein. *L.Th.A.* Long Thoracic Artery. *S.S.M.* Subscapularis Muscle. *P.Th.N.* Posterior Thoracic Nerve. *S.M.M.* Serratus Magnus Muscle. *M.S.N.* Middle Subscapular Nerve. *L.D.* Latissimus Dorsi. *D.S.A.* Dorsalis Scapulæ Artery. *I.H.N.* Intercosto-humeral Nerve. *L.I.C.N.* Lesser Internal Cutaneous Nerve. *Te.Ma.* Teres Major. *I.C.N.* Internal Cutaneous Nerve. *S.S.Vv.* Subscapular Vessels. *I.S.N.* Inferior Subscapular Nerve. *B.V.* Basilic Vein. *V.C.* Venæ Comites. *U.N.* Ulnar Nerve. *Bi.* Biceps (Long Head). *M.N.* Median Nerve. *C.N.* Circumflex Nerve. *B.* and *C.B.* Short Head of Biceps and Coracobrachialis. *D.* Deltoid. *N.C.B.* Nerve to Coraco-brachialis. *M.C.N.* Musculo-cutaneous Nerve.

found ; it is surrounded by condensed cellular tissue, and so requires careful cleaning. Its tendon of origin from the inner end of the first rib is continued along the lower border of the muscle, where it is in contact with the axillary vein, so that the vein is not compressed by the swelling up of the muscle during contraction. The insertion of the muscle into the middle third of the lower surface of the clavicle, as well as its nerve supply, cannot be seen very well at present.

Notice that in many positions of the shoulder the subclavius and pectoralis minor are in contact, except where the vessels and nerves pass forward between them.

In cleaning the upper border of the pectoralis minor look for an artery running along it toward the thorax. This is the *superior thoracic* [A. thoracalis suprema], a branch either of the axillary or of the acromio-thoracic. Along the lower border of the pectoralis minor a larger artery, the *long thoracic* [a. thoracalis lateralis], will be found ; it is a branch of the axillary, and is specially important, because a group of lymphatic nodes is placed along its course, and these drain a large part of the breast in the female. They are, therefore, of great importance to the surgeon, and must always be removed after amputation of the breast for cancer. Cut the pectoralis minor through at about its middle and reflect the two parts, when the axilla will be completely exposed from in front. Some idea may now be gained of the shape and dimensions of the space. It is a four-sided pyramid with the apex cut off, the base being formed by the skin of the armpit. Its anterior wall, as has been seen, is formed by the two pectoral muscles. Posteriorly it is bounded from above down by the subscapularis, latissimus dorsi, and teres major muscles. Internally is the thoracic wall, with the serratus magnus rising from it ; while externally the humerus and coraco-brachialis muscle form its wall. At its apex it communicates with the posterior triangle of the neck through a triangular space bounded in front by the clavicle, behind by

the upper part of the scapula, and internally by the first rib. It contains (1) the axillary artery; (2) the axillary vein; (3) the brachial plexus of nerves; (4) the branches and tributaries of the foregoing; (5) numerous lymphatic nodes; (6) the intercosto-humeral nerve; (7) a quantity of loose cellular tissue packing up all these structures and continuous with the same tissue in the neck, with the superficial and deep fasciæ of the arm as well as with the superficial fascia of the side of the trunk, and, round the anterior and posterior axillary folds, with the superficial fascia of the chest and back. No definite fascial sheets comparable to the deep fascia of the arm are present during life, or indeed after death, until the skill of the dissector manufactures them.

The laxness of this tissue allows abscesses, generally arising from inflamed lymphatic nodes, to reach a great size before coming to the surface.

Dissecting the axilla simply means clearing away all this cellular tissue, though it is much more easily talked about than done.

In the actual dissection, although no one structure is completely cleaned and then left for another, it is better to have some system in approaching this difficult piece of work. The method the author would recommend is to work down the outer side of the axilla from above, taking the axillary artery as the main guide.

Do not get into the way of scraping, but make a series of short, shallow cuts with the point of a sharp knife, looking very carefully after each cut to see whether any structure is visible which might be cut with the next. The veins are the greatest trouble, since when cut they often bleed most annoyingly. It is a good plan to have some silk or thread at hand and to ligature any bleeding points. The dissection will be made easier if the veins accompanying all the smaller arterics are tied in this manner and deliberately cut away. It may then be safely assumed that each artery had its vena comes or venæ comites.

In following the axillary artery down replace the pectoralis minor for a minute, and notice that it arbitrarily divides the artery into three parts, one above, one behind, and a third below. This division, of course, varies with different positions of the limb, still it is a convenient one as long as the student clearly realises that its limits are variable and uncertain. In each stage of the artery it will have anterior, posterior, internal and external relations, a search for which will bring the dissector into touch with all the important structures in the axilla.

First part of the axillary artery, running from the outer edge of the first rib to the upper border of the pectoralis minor.

The *anterior relations* of this part are :—

Bones.—The clavicle when the shoulder is depressed.

Muscles.—Subclavius and pectoralis major.

Fibrous Structures.—Costo-coracoid membrane or cellular tissue and costo-coracoid ligament.

Arteries.—Acromio-thoracic and some of its branches.

Veins.—Axillary and cephalic, receiving the acromio-thoracic tributaries.

Nerves.—External anterior thoracic.

Glandular and other Structures.—Infraclaviular lymphatics.

It will be noticed that every one of these structures has already been examined in exposing the artery.

The *posterior relations* of the first part are :—

Bones.—None.

Muscles.—Serratus magnus.

Fibrous Structures.—Cellular tissue.

Arteries.—None.

Veins.—None.

Nerves.—The posterior thoracic or nerve of Bell and the inner cord of the plexus.

Glandular and other Structures.—None.

These relations introduce two structures which have not

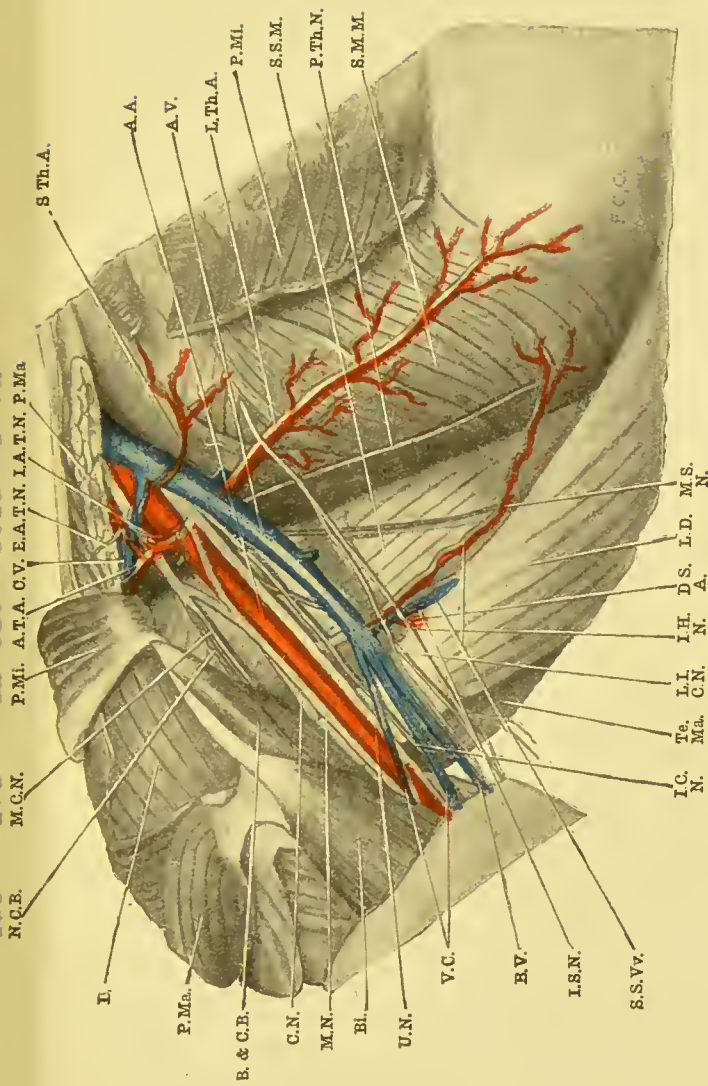


FIG. 294.—DISSECTION OF THE AXILLA.

Pi.Mi. Pectoralis Minor. *A.T.A.* Acromio-thoracic Artery. *C.V.* Cephalic Vein. *E.A.T.N.* External Anterior Thoracic Nerve. *I.A.T.N.* Internal Anterior Thoracic Nerve. *P.Ma.* Pectoralis Major. *S.Th.A.* Superior Thoracic Artery. *A.A.* Axillary Artery. *A.V.* Axillary Vein. *L.Th.A.* Long Thoracic Artery. *S.S.M.* Subscapularis Muscle. *P.Th.N.* Posterior Thoracic Nerve. *S.M.M.* Serratus Magnus Muscle. *M.S.N.* Middle Subscapular Nerve. *L.I.C.N.* Lesser Intercosto-humeral Nerve. *I.H.N.* Intercosto-humeral Nerve. *L.I.C.N.* Lesser Internal Cutaneous Nerve. *Te.Ma.* Teres Major. *I.C.N.* Internal Cutaneous Nerve. *S.S.V.* Subscapular Vessels. *I.S.N.* Inferior Subscapular Nerve. *B.V.* Basilic Vein. *V.C.* Venæ Comites. *U.N.* Ulnar Nerve. *Bi.* Biceps (Long Head). *M.N.* Median Nerve. *C.N.* Circumflex Nerve. *B. and C.B.* Short Head of Biceps and Coraco-brachialis. *D.* Deltoid. *N.C.B.* Nerve to Coraco-brachialis. *M.C.N.* Musculo-cutaneous Nerve.

hitherto been considered—the serratus magnus and the posterior thoracic nerve.

The *Serratus magnus* [m. serratus anterior] runs backwards from the upper eight ribs to the vertebral border of the scapula, which it pulls forwards, thereby increasing a person's reach by about three inches. It makes all the difference between the thrust and the lunge in fencing, and is sometimes known as the fencer's muscle.

The whole of its origin by fleshy digitations from the ribs should be cleaned, and it will then be seen that the first of them comes from the first and second ribs and passes outwards and backwards behind the artery. The second digitation comes from the second rib behind and below the first, so that the second rib has two digitations attached to it. From the fifth to the eighth ribs the serratus magnus interdigitates with the external oblique muscle of the abdomen.

In cleaning the origin of this muscle notice how the lateral cutaneous nerves, already found, come out between the digitations, having already divided into anterior and posterior branches.

The work of cleaning the surface of the serratus magnus should be continued backwards until the *posterior thoracic nerve* [n. thoracalis longus] comes into view, running vertically downwards on the inner wall of the axilla, and giving off branches to the different serrations of the serratus magnus. Follow it up to where it passes behind the first part of the axillary artery, and notice that it is the only structure of any importance on the inner wall of the axilla. For this reason when an incision has to be made into the axilla the edge of the knife is turned towards the inner wall.

The dissectors of the head and neck will later on show the origin of the posterior thoracic nerve from the fifth, sixth, and usually the seventh cervical nerves (see p. 38, vol. i.).

The only internal relations of the first part of the axillary artery are the axillary vein and cellular tissue, so

that this will be a convenient opportunity to examine the whole course of this vein.

The *Axillary vein* is, like all veins, liable to variation, but generally begins by the junction of the *venæ comites* of the brachial artery, the basilic vein, and the subscapular vein. This union usually happens close to the lower edge of the subscapularis or, what is nearly the same thing, the lower edge of the *pectoralis minor*. It is therefore exceptional to find a large single vein accompanying the third part of the axillary artery, and for this reason the anterior and posterior circumflex tributaries are generally received by the *venæ comites* accompanying the artery here.

The other tributaries correspond to the branches of the axillary artery, except that the cephalic vein takes the place of and receives tributaries corresponding to the *acromiothoracic*.

Where large tributaries are received or important junctions effected is the place to look for valves in veins; one or more might therefore be expected close to the lower border of the subscapularis. As a rule, there is no need to slit open the vein to see these, because the bulging of the blood above is so marked. If, however, the dissector wishes to see what a venous valve is like, he should ligature the vein half an inch above the valve as well as the veins below; then the vein may be longitudinally incised and the blood and clot sponged out.

Be very careful in dissecting the vein to look out for lymphatic nodes in close relationship to its wall and lying to its inner side; the nodes found in this chain are often so small in old people that they are not seen. After an amputation of the breast for cancer, the inner surface of the vein is cleaned in removing the fat, cellular tissue and lymphatic nodes of the axilla.

The *external relation of the first part of the axillary artery* is the brachial plexus, the construction of which is described on p. 43, vol. i. Below the clavicle only the three

cords with their branches are found, and in its first part these are all massed on the outer side and somewhat behind the artery. Here, too, the external anterior thoracic nerve is given off from the outer cord, and so it is an external as well as an anterior relation of the artery.

The branches of the first part of the axillary artery are the acromio-thoracic and the superior thoracic, both of which have been dissected.

The *second part of the axillary artery* lies behind the pectoralis minor. Its only *anterior relations* are that muscle and the internal anterior thoracic nerve.

The *internal anterior thoracic nerve* has been seen piercing the pectoralis minor muscle, which it supplies, and then goes on to innervate the lower half of the pectoralis major. When the pectoralis minor is reflected the nerve should be looked for coming forward between the axillary artery and vein at a considerably lower level than the external anterior thoracic. It usually forms a loop of communication with the external anterior thoracic, which runs obliquely in front of the artery.

The posterior relations of the second part of the axillary artery are the subscapularis muscle, separated by a good deal of cellular tissue, and the posterior cord of the brachial plexus. Coming off from this cord, either here or higher up, are the three subscapular nerves, which should now be looked for.

The *upper subscapular nerve* needs rather careful search; hook the axillary vessels and brachial plexus outwards, when the nerve, which may be double, is seen entering the anterior surface of the subscapularis about midway between its upper and lower borders and also between its origin and insertion.

The *middle or long subscapular nerve* enters the latissimus dorsi, in which it ends. It accompanies the subscapular artery, and, if the lower border of the subscapularis is carefully cleaned, is sure to be found.

The *lower subscapular nerve* supplies the *teres major*, and sends a branch to the lower border of the *subscapularis*. It lies outside the long *subscapular*, nearer the axillary vessels, and is close to the *dorsalis scapulæ* branch of the *subscapular artery*. As the lower border of the *subscapularis* is cleaned, toward the humerus it will come into view.

The internal relations of the second part of the axillary artery are the axillary vein, the inner cord of the brachial plexus, and the internal anterior thoracic nerve. Notice that the vein, accompanied by its chain of small lymphatic nodes, lies quite on the inner side of the artery now, and does not overlap it in front, as it did in the first part of the artery's course.

The external relations of the second part of the axillary artery are the coracoid process, a little distance away, and the outer cord of the brachial plexus.

It will be noticed that in the second part of the artery the three cords lie each on its own aspect of the artery.

The branches of the second part of the axillary artery are the long and alar thoracic. The *long thoracic* has already been traced along the lower border of the *pectoralis minor*, while the *alar thoracic* is any small artery or arteries supplying the lymphatic nodes and cellular tissue, whether it rises from the axillary direct or from some of its branches.

The third part of the axillary artery runs from the lower border of the *pectoralis minor* to the lower border of the *teres major*. A glance at it, when the *pectoralis minor* is replaced, shows that it is more than twice as long as the other two parts put together.

The anterior relations of the third part of the axillary artery are :—

Bones.—None.

Muscles.—*Pectoralis major*.

Fibrous Structures.—The deep fascia of the arm, gradually disappearing in the axillary cellular tissue.

Arteries.—None.

Veins.—The external vena comes crossing to help form the axillary vein.

Nerves.—Inner head of the median, sometimes double.

Glandular and other Structures.—The lower lymphatics of the chain accompanying the axillary vessels. These, as has been pointed out, are more closely in touch with the vein than with the artery.

Replace the pectoralis major, and notice that its lower margin does not come as low as that of the teres major; it is therefore quite easy to expose and ligature the third part of the axillary artery by an incision in the long axis of the arm, through the floor of the axilla, a little nearer the anterior than the posterior fold.

Sometimes the third part of the artery is crossed by some fleshy fibres running from the lower border of the pectoralis major to that of the latissimus dorsi. Comparative anatomy leaves us in no doubt that these are remnants of the panniculus carnosus or skin musculature, and they are common enough to be worth a surgeon's notice.

The posterior relations of the third part of the axillary artery are the subscapularis, latissimus dorsi, and teres major muscles, as well as the two main branches of the posterior cord of the brachial plexus, namely, the musculospiral and circumflex nerves.

The *musculo-spiral nerve* [n. radialis] is the largest of all the branches of the brachial plexus; it is easily found by drawing the artery aside and looking behind. It passes down, with the artery, in front of the latissimus dorsi and teres major muscles.

The *circumflex nerve* [n. axillaris] is one which, we have observed, a student often has difficulty in finding readily in the examination-room. Draw the axillary artery outwards, and look for a nerve behind it rather smaller than the musculospiral, and on the outer side of the latter. It keeps close to the lower border of the subscapularis muscle, and dives backwards round this border to disappear in the quadrilateral

space described later. It does not pass in front of the latissimus dorsi and teres major, a fact which distinguishes it at once from the musculo-spiral. When it is missed, it is usually because it is not looked for high enough in the axilla.

The internal relations of the third part of the axillary artery are: (1) The formation of the axillary vein by the union of the venæ comites and the basilic vein; these have already been noticed (see p. 263); (2) the terminal branches of the inner cord of the brachial plexus, namely, the internal cutaneous, the ulnar, and the lesser internal cutaneous nerves.

The *internal cutaneous* [n. cutaneus antibrachii medialis] is a comparatively small nerve lying in the groove between the axillary artery and vein, when the latter is formed.

The *ulnar nerve* is larger than the internal cutaneous and lies behind it, also between the artery and vein.

The *lesser internal cutaneous nerve* [n. cutaneus brachii medialis] is quite small and crosses behind the vein to lie on its inner side, where it should be looked for. This nerve, the only branch of the brachial plexus internal to the vein, usually communicates with the *intercosto-humeral*, the lateral cutaneous branch of the second intercostal nerve, and so the two may vary inversely in size. Sometimes even the intercosto-humeral may entirely replace the lesser internal cutaneous.

The external relations of the third part of the axillary artery are the coraco-brachialis muscle and the terminal branches of the outer cord of the plexus, namely, the musculo-cutaneous and outer head of the median nerves. In addition to these the upper part of the shaft of the humerus, although not in direct relationship, is so near that the artery during life may easily be compressed against it.

The *musculo-cutaneous nerve* is easily distinguished, because it pierces the coraco-brachialis muscle opposite the lower border of the teres major. Some distance before this

a small twig is given off to supply the coraco-brachialis, and this must be looked for with great care as it is not very often seen.

The *outer head of the median* is joined by the inner head in the lower part of the axilla, and then the median nerve, thus formed, continues its course on the outer side of the artery.

The *branches of the third part of the axillary artery* are the subscapular, the anterior circumflex, and the posterior circumflex.

The *subscapular artery* [a. thoraco-dorsalis] is the largest branch of the axillary, and rises opposite the lower border of the subscapularis muscle, which it accompanies to the lower angle of the scapula. About an inch from its origin it gives off the dorsalis scapulæ, which, although called a branch, is really larger than the continuation of the subscapular. The main subscapular then gives off muscular branches to the subscapularis, teres major, latissimus dorsi, and serratus magnus muscles, and is especially important because a chain of well-marked lymphatic nodes is ranged along its course. The nodes drain the back and side of the trunk as low as the umbilical zone.

The *dorsalis scapulæ branch* [a. circumflexa scapulæ] disappears backwards between the subscapularis and teres major; it too is accompanied by some nodes which drain the dorsal scapular region.

The *anterior circumflex artery* [a. circumflexa humeri anterior] is small and runs round the front of the surgical neck of the humerus deep to the coraco-brachialis and biceps.

The *posterior circumflex artery* [a. circumflexa humeri posterior] is much larger and runs backwards, through the quadrilateral space, close to the surgical neck of the humerus. It is on a lower level than the circumflex nerve.

At this point it may be well to recapitulate the *lymphatic nodes of the axilla*, since they are of such great practical importance. It will be remembered that a vertical chain

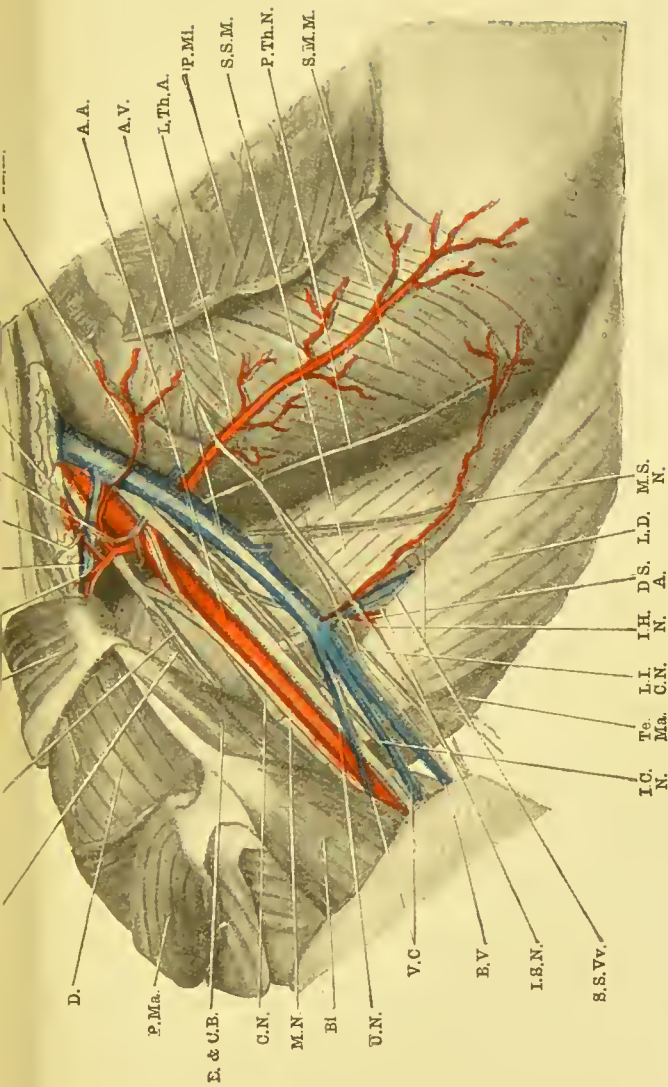


FIG. 295.—DISSECTION OF THE AXILLA.

P.Ma. Pectoralis Minor. *A.T.A.* Acromio-thoracic Artery. *C.V.* Cephalic Vein. *E.A.T.N.* External Anterior Thoracic Nerve. *I.A.T.N.* Internal Anterior Thoracic Nerve. *P.Ma.* Pectoralis Major. *S.Th.A.* Superior Thoracic Artery. *A.A.* Axillary Artery. *A.V.* Axillary Vein. *L.Th.A.* Long Thoracic Artery. *S.S.M.* Subscapularis Muscle. *P.Th.N.* Posterior Thoracic Nerve. *S.M.M.* Serratus Magnus Muscle. *M.S.N.* Middle Subscapular Nerve. *L.D.* Latissimus Dorsi. *D.S.A.* Dorsalis Scapulæ Artery. *I.H.N.* Intercosto-humeral Nerve. *L.I.C.N.* Lesser Internal Cutaneous Nerve. *Te.Ma.* Teres Major. *I.C.N.* Internal Cutaneous Nerve. *S.S.Vv.* Subscapular Vessels. *I.S.N.* Inferior Subscapular Nerve. *B.V.* Basilic Vein. *V.C.* Venæ Comites. *U.N.* Ulnar Nerve. *Bi.* Biceps (Long Head). *M.N.* Median Nerve. *C.N.* Circumflex Nerve. *B.* and *C.B.* Short Head of Biceps and Coracobrachialis. *D.* Deltoid. *N.C.B.* Nerve to Coraco-brachialis. *M.C.N.* Musculo-cutaneous Nerve.

along the axillary vessels, and two oblique chains along the long thoracic and subscapular vessels respectively, have been looked for. The vertical chain is arbitrarily divided into three groups. The lower vertical nodes are sometimes called the *brachial group* because they receive most of the lymphatics of the arm. The middle group of vertical nodes receive lymphatics from the last as well as from the subscapular and pectoral chains.

The upper vertical nodes or *infra-clavicular group* receive vessels from all the outer groups as well as some which accompany the cephalic vein from the outer side of the arm. The chain along the long thoracic vessels (*pectoral group*) drains the chest, including the greater part of the female breast, while the *subscapular group* along the subscapular vessels drains the back. A *central group* of small nodes, lying about the middle of the floor of the axilla, is sometimes described. What they drain is not known with certainty, nor are they always to be found. It must be remembered that lymphatics anastomose very freely, consequently surgeons find it advisable to remove every node they can reach from the axilla after amputating the breast for cancer.

By this time the dissectors of the head and neck will be ready to divide the clavicle about its middle, and a full view of the brachial plexus will be obtained. With the aid of the accompanying diagram the three trunks, each dividing into anterior and posterior secondary divisions, will be seen, the secondary divisions uniting to form the three cords which alone are found below the level of the clavicle. The dissectors of the two parts should now try to find out from which spinal nerves the branches of the plexus derive their fibres. A glance at the construction of the plexus shows that branches of the outer cord can only come from *C.* 5, 6, and 7, while those from the inner are confined to *C.* 8 and *Th.* 1. In the posterior cord, on the other hand, there is a wider range, since fibres continue into it from *C.* 5, 6, 7, and 8, though seldom from *Th.* 1.

It is possible in a subject well hardened with formalin to trace any or all of the branches of the plexus to the spinal cord with the scalpel and forceps, though the process is somewhat tedious. One or two nerves, however, should be

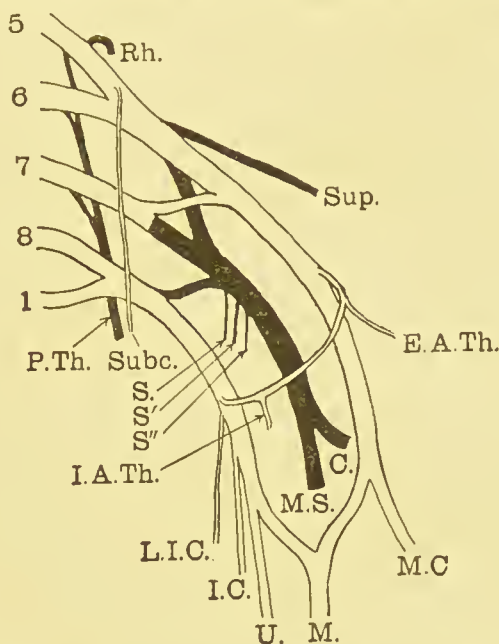


FIG. 296.—THE COMPOSITION OF THE BRACHIAL PLEXUS.

(The dorsal nerves are black, the ventral, white.)

5, 6, 7, 8, 1. The Cervical and Thoracic Nerves. *Rh.* Nerve to Rhomboids. *P.Th.* Posterior Thoracic. *Subc.* Nerve to Subclavius. *Sup.* Suprascapular Nerve. *S.*, *S'*, *S''*. The Upper, Middle, and Lower Subscapular Nerves. *E.A.Th.* External Anterior Thoracic Nerve. *I.A.Th.* Internal Anterior Thoracic Nerve. *M.C.* Musculo-cutaneous Nerve. *M.* Median Nerve. *U.* Ulnar Nerve. *I.C.* Internal Cutaneous Nerve. *L.I.C.* Lesser Internal Cutaneous Nerve. *C.* Circumflex Nerve. *M.S.* Musculo-spiral Nerve.

taken as examples, and there are few more manageable than the musculo-cutaneous. This, steadily traced up, will be seen to come from *C.* 5 and 6, but the little branch of it to the coraco-brachialis comes from *C.* 7.

The circumflex is another nerve worthy of being specially

traced to its origin, because it comes very largely from C. 5, which is higher than might be expected. It is in this way, combined with pathological and physiological observation, that the distribution of each spinal nerve to skin and muscles has been plotted out.

The great vessels and brachial plexus should now be tied together on a level with the first rib, and divided above the ligature. Draw the arm away from the trunk, and notice that the only things now holding it in position are the subclavius, serratus magnus, and omo-hyoid muscles, unless the dissectors of the head and neck have already divided the latter muscle and the supra-scapular nerve and artery.

As the extremity will soon be removed, it will be a neighbourly act to give the dissectors of the head and neck a warning in order that they may verify any points about the base of the posterior triangle. Cut the subclavius and look for the nerve entering its deep surface, if the dissectors of the neck have been fortunate enough to find it.

Identify the suprascapular nerve and artery, accompanying the posterior belly of the omo-hyoid muscle to the supra-scapular notch, and notice that the muscle is attached to the ventral surface of the bone just internal to the notch. Cut these three structures some distance from the bone in order to find them again easily.

Put the *serratus magnus* on the stretch, and notice that it is inserted into the whole length of the vertebral border of the scapula on its ventral or anterior surface. The upper serration, from the first and second ribs, will be found inserted near the upper angle of the scapula. The next two serrations, from the second and third ribs, spread out into a fan, and are inserted into the whole length of the vertebral border, while the rest of the serrations, from the fourth to the eighth ribs, converge to an insertion into the ventral surface of the scapula, close to the lower angle. The muscle is therefore in three parts, the uppermost being rectangular, the

intermediate triangular with its apex forwards, while the lower is triangular with its apex backwards.

Now divide the muscle and remove the limb.

THE REGION OF THE SHOULDER

Carry the vertical incision already made on the outer side of the shoulder down as far as the insertion of the deltoid, that is, to about the middle of the arm. Remember that anatomically the arm is the region between the shoulder and elbow joints.

Reflect the skin downwards all round as far as this level, looking out carefully for cutaneous branches of the *circumflex nerve*, supplying the skin superficial to the lower half of the deltoid, as well as for twigs of the *supra-acromial nerve* supplying the area superficial to the upper half of the muscle. Most of the *circumflex cutaneous branches* wind round the posterior border of the deltoid and should be picked up here, but a few pierce the muscle farther forward.

Be careful, too, of the *cephalic vein* running along the anterior border of the deltoid, between it and the pectoralis major.

A little below the circumflex branches, between the inner border of the triceps and the posterior axillary fold, the *internal cutaneous branch of the musculo-spiral nerve* should be sought; this supplies the greater part of the back of the arm.

Clean the *deltoid muscle*, and notice the arrangement of its fibres; those near the anterior and posterior borders are long and linear, but the middle ones are bipenniform, rising from and being inserted into vertical fibrous plates, which lie at right angles to the surface of the muscle. Make out the origin of the muscle from the anterior border of the outer third of the clavicle, from the external and posterior borders of the acromion, and from the lower border of the spine of the scapula, as well as its insertion into the

V-shaped impression half-way down the outer surface of the humerus.

To see the four or five fibrous plates of origin, make a deep transverse cut into the muscle a little below the acromial process, while the three or four plates of insertion

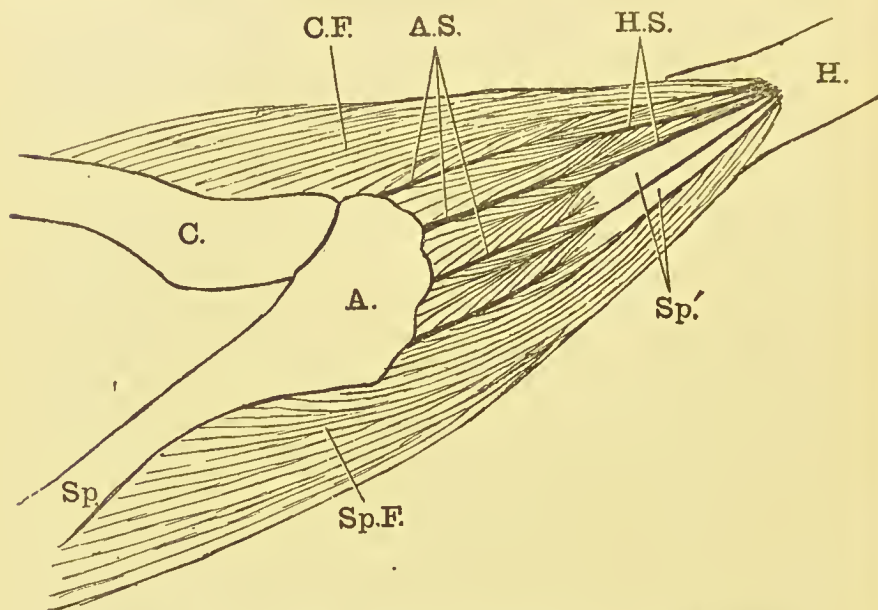


FIG. 297.—DIAGRAM OF THE STRUCTURE OF THE RIGHT DELTOID MUSCLE.

C. Clavicle. A. Acromion. Sp. Spine. C.F. Clavicular Fibres. Sp.F. Spinal Fibres. A.S. Acromial Septa or Plates of Origin. H.S. Humeral Septa or Plates of Insertion. H. Humerus. Sp'. Two spaces from which the Fibres have been removed.

will be seen if another cut is made an inch or so above the insertion.

Divide the muscle transversely about an inch below its origin, and turn it downwards.

The structures deep to the deltoid are now displayed; they are:—

Bones.—(1) Coracoid process of the scapula; (2) both tuberosities and upper part of the shaft of the humerus.

Ligaments.—(3) Coraco-clavicular; (4) coraco-acromial.

Muscles.—Insertions of (5) Subscapularis; (6) supra-spinatus; (7) infra-spinatus; and (8) teres minor. Origins of (9) coraco-brachialis; and (10) short head of biceps.

Vessels.—(11) Anterior circumflex; (12) posterior circumflex; and (13) acromial branch of acromio-thoracic.

Nerves.—(14) Circumflex.

Bursae.—(15) Subacromial bursa.

The *subacromial bursa* should be examined at once before it is damaged. It is a large sac, with glistening walls lining the upper part of the deep surface of the deltoid, the deep surfaces of the acromial process and coraco-acromial ligaments, and the superficial surface of the tendons of insertion of the supra- and infra-spinatus muscles. Its interior should be explored with a probe or seeker, and in some cases it will be found to be multilocular from septa and strands passing across it. These septa when present are worth noticing, because they indicate the gradual transition from ordinary cellular to bursal tissue.

The joints and ligaments may be studied as they are reached, or the whole of them may be left till all the other soft parts have been dealt with. On the whole, we think the latter preferable, because the different kinds of joints may then be so much more readily compared. The risk of their drying up is very slight, now that tanks are usually provided for storing the extremities.

The *subscapularis muscle* will be seen to rise from the ventral surface of the scapula, though it does not reach the vertebral border, because of the insertion of the serratus magnus. Its insertion is into the lesser tuberosity of the humerus. Cut it right through from above downwards, just internal to the position of the shoulder joint, and turn the origin aside; it will then be seen that the muscle does not rise from, but only plays over, that part of the subscapular fossa which is near the joint, and that bursal tissue intervenes between them. Another vertical incision, nearer the origin

will cut through fibrous plates of origin, like those in the deltoid, rising from the ridges or costæ of the scapula, and giving attachment to short bipenniform fibres. Notice that, as the muscle passes directly in front of the shoulder joint, it must be an internal rotator. The double nerve supply of the subscapularis has been seen already. Do not separate the tendon from the capsule of the shoulder at present.

The *supra-spinatus* rises from the inner part of the supra-spinous fossa and from the upper surface of the spine on the dorsum of the scapula; it runs directly above the shoulder joint, to be inserted into the upper facet on the great tuberosity of the humerus. Cut the muscle just internal to the shoulder joint and turn the origin aside, looking carefully for a nerve entering its deep surface from the supra-scapular. Since the muscle passes above the shoulder joint it must clearly be an abductor (see Fig. 298).

The *supra-scapular artery* [a. transversa scapulæ] and *nerve* [n. supra-scapularis] may now be traced through the supra-scapular notch, the artery lying above and the nerve below the supra-scapular ligament which converts the notch into a foramen (occasionally this ligament is ossified). After leaving the notch the two structures run towards the outer limit of the attachment of the scapular spine, the nerve, as has been seen, supplying the supra-spinatus, the artery giving off several branches to the muscle, some of which anastomose with branches of the posterior scapular artery, while others, in a well-injected part, are seen to form a delicate network superficial to the acromial process, where they anastomose with the acromio-thoracic artery.

With very great care a small twig of the nerve may be followed in the substance of the supra-spinatus to the shoulder joint.

The *infra-spinatus muscle* rises from the inner part of the infra-spinous fossa, and the lower surface of the spine to be inserted into the middle of the three facets on the great

tuberosity of the humerus; its surface is covered by a dense fascia, which is of morphological rather than practical interest. The lower border of the muscle is in very close contact with the teres minor, and in dividing the infra-spinatus care should be taken not to cut the teres minor too. When it is divided,

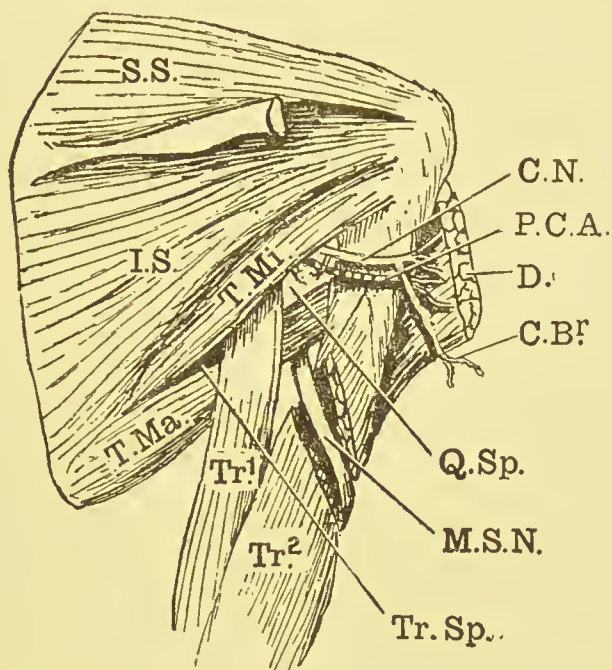


FIG. 298.—DISSECTION OF THE SHOULDER REGION FROM BEHIND.

S.S. Supra-spinatus Muscle. *I.S.* Infra-spinatus. *T.Mi.* Teres Minor. *T.Ma.* Teres Major. *D.* Deltoid. *C.N.* Circumflex Nerve. *C.Br.* Its Cutaneous Branch. *P.C.A.* Posterior Circumflex Artery. *Q.Sp.* Quadri-lateral Space. *M.S.N.* Musculo-spiral Nerve. *Tr.Sp.* Triangular Space. *Tr¹.* Long Head of Triceps. *Tr².* External Head of Triceps cut.

just internal to the shoulder joint and its origin turned aside, the supra-scapular nerve will be seen entering the muscle on its deep surface and supplying it.

An important anastomosis takes place in the infra-spinous fossa between the end of the supra-scapular artery, branches of the posterior scapular coming through the

tendinous arch of the rhomboideus major and terminal twigs of the dorsalis scapulæ branch of the subscapular artery passing between the teres minor and the axillary border of the scapula. When the axillary artery is ligatured above the origin of the subscapular, this anastomosis will enlarge and form a collateral channel for the blood to pass between the thyroid axis of the subclavian and the lower part of the axillary *via* the subscapular artery.

The *teres minor* is the small muscle which rises from the middle third of the dorsal aspect of the axillary border of the scapula, and is inserted into the lowest of the three facets on the great tuberosity of the humerus. Both it and the infraspinatus pass behind the shoulder joint, and so must be external rotators. Do not cut it at present.

The *teres major muscle* rises from the dorsum of the scapula near the lower third of the axillary border, and passes outward in front of the surgical neck of the humerus to be inserted into the inner lip of the bicipital groove. It has a short tendon just before its insertion. It must clearly be an internal rotator, because it passes in front of the humerus, while, if the position of its origin be looked at with regard to its insertion, it must just as clearly adduct and slightly extend the humerus. Its nerve supply from the lower subscapular nerve has been seen already.

The Insertion of the Latissimus Dorsi.—The greater part of this muscle has been examined while the body was lying on its face (see p. 243). It was left where it was wrapping round the lower border of the teres major, and this is where it should now be picked up. It very soon becomes quite anterior to the teres major, and then contracts into a flat, riband-like tendon, which, once seen, should never be mistaken, since it is like no other tendon in the arm. The tendon is inserted into the floor of the bicipital groove on a little higher level than the insertion of the teres major, the two being connected a little distance from their insertion, though separated by a bursa at their actual attachments.

The latissimus dorsi has the same action as the teres major, though, owing to the length of its fibres, it is more useful as an adductor than as a rotator.

Until they are artificially separated, the upper edge of the teres major and the lower edge of the subscapularis are in close apposition, except where the posterior circumflex artery and circumflex nerve are passing between them, close to the humerus, and the dorsalis scapulæ artery is running backwards more internally.

Separate the two muscles and draw the teres major downwards, in doing which the long head of the *triceps* will be exposed, rising from the axillary border of the scapula just below the glenoid cavity and running vertically downwards, a little internal to the humerus, behind the teres major muscle and close to the bone.

Here, as seen from in front, is the *quadrilateral space of the upper part of the arm*, and its boundaries are: above, the subscapularis; below, the teres major; externally, the surgical neck of the humerus; internally, the long head of the triceps.

On turning the part over, a posterior view of the quadrilateral space is obtained; its boundaries are the same as those in front, except that the teres minor replaces the subscapularis as the upper limit (see Fig. 298). Through this quadrilateral space pass the circumflex nerve above and the posterior circumflex artery below. It is easy to remember this relationship when it is recalled how closely the nerve clings to the lower border of the subscapularis as it enters the space.

Great care must be taken in cleaning the circumflex nerve in this space; the work should be done both from in front and behind. Hook the posterior circumflex artery and its veins well away, and sacrifice any of their twigs which obscure the nerve.

By working very carefully, a little branch running up into the shoulder joint may be found, after which the circumflex nerve will be seen to divide into an anterior and a posterior

branch. Trace the posterior one first, and look for a twig which it gives off to the *teres minor* muscle, swelling at one point into a gangliform enlargement or pseudo-ganglion (see Fig. 299).

These pseudo-ganglia differ from the true ganglia on the

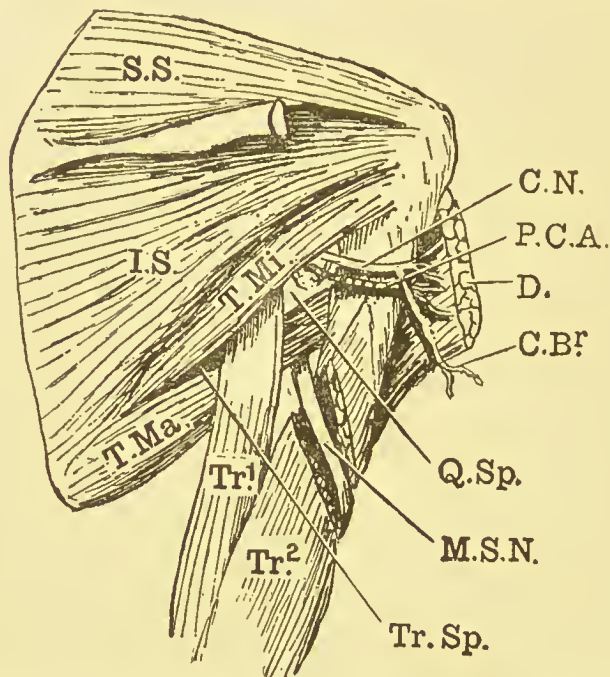


FIG. 299.—DISSECTION OF THE SHOULDER REGION FROM BEHIND.

S.S., Supra-spinatus Muscle. *I.S.*, Infra-spinatus. *T.Mi.*, Teres Minor. *T.Ma.*, Teres Major. *D.*, Deltoid. *C.N.*, Circumflex Nerve. *C.Br.*, Its Cutaneous Branch. *P.C.A.*, Posterior Circumflex Artery. *Q.Sp.*, Quadri-lateral Space. *M.S.N.*, Musculo-spiral Nerve. *Tr.Sp.*, Triangular Space. *Tr¹*, Long Head of Triceps. *Tr²*, External Head of Triceps cut.

posterior roots of spinal nerves in not possessing ganglion cells.

The rest of the posterior branch supplies the posterior part of the deltoid muscle and winds round its posterior border, as has been seen already. The anterior branch enters and supplies the front of the deltoid, although numerous

cutaneous twigs pierce the muscle and supply the skin covering it.

The *posterior circumflex artery* [a. circumflexa humeri posterior] should now be traced through the space into the deltoid muscle. Its close relation to the surgical neck of the humerus is important, since it is so often lacerated in fractures and dislocations here, and is the cause of great extravasation of blood.

On the inner side of the long head of the triceps is the *triangular space of the upper part of the arm*; it is bounded externally by the triceps, superiorly by the subscapularis when looked at from in front, and by the teres minor when looked at from behind, inferiorly by the teres major.

When looked at from in front, the *dorsalis scapulae* branch of the subscapular artery seems to be passing through, though, before reaching the back, it dips in between the teres minor and the axillary border of the scapula, grooving the bone and usually dividing into an upper and a lower branch as it does so.

THE ARM

SURFACE MARKINGS

First study the surface markings, using the bared arm of a companion to contrast the landmarks during life with those on the dead body.

In considering the surface markings of the pectoral region the coraco-brachialis was noticed. Just to its outer side is the prominence of the biceps occupying the front of the arm, and on each side of this is a groove, the *external* and *internal bicipital sulcus*.

Deep to the internal bicipital sulcus lies the basilic vein, and, deeper still, the brachial artery and median nerve.

Deep to the outer bicipital sulcus, which is not so well marked as the inner, lies the cephalic vein.

As the bend of the elbow is approached, the two sulci turn towards one another, owing to the biceps narrowing into its tendon. This, in the living body, is a very prominent landmark when the forearm is slightly flexed, and it can be gripped between the finger and thumb, even through the coat-sleeve.

Close to its outer side is the spot at which the musculocutaneous nerve becomes superficial, while on its inner side lies the lower end of the brachial artery and, more internally still, the median nerve. Both of these are covered by the bicipital fascia, the upper edge of which can be felt readily.

The superficial veins in front of the elbow can be easily demonstrated in the living body, especially if the arm is allowed to hang down; they are very variable, and usually differ on opposite sides of the same body.

The two condyles of the humerus are easily felt, though the inner one is much more prominent. The outer condyle is concealed in front by the swelling of the brachio-radialis and extensor carpi radialis muscles, which account for the full and graceful curve of the upper and outer part of the forearm. Above each condyle the supracondylar ridge may be felt, the outer being the more evident and being crossed from behind forwards by the musculo-spiral nerve about two inches above the external condyle. Deep pressure on the ridge about this point in a living person will soon satisfy him as to the exact position of the nerve.

Neither the upper end of the radius nor that of the ulna can be felt from the front of the elbow. They are both too thickly covered with muscle.

It should be carefully noticed that a good deal of the triceps is visible from the front of the arm; all the mass which is seen on the inner side of the internal bicipital sulcus is formed by the long head of this muscle above and the inner head below.

On the back of the arm all three heads of the triceps may be made out.

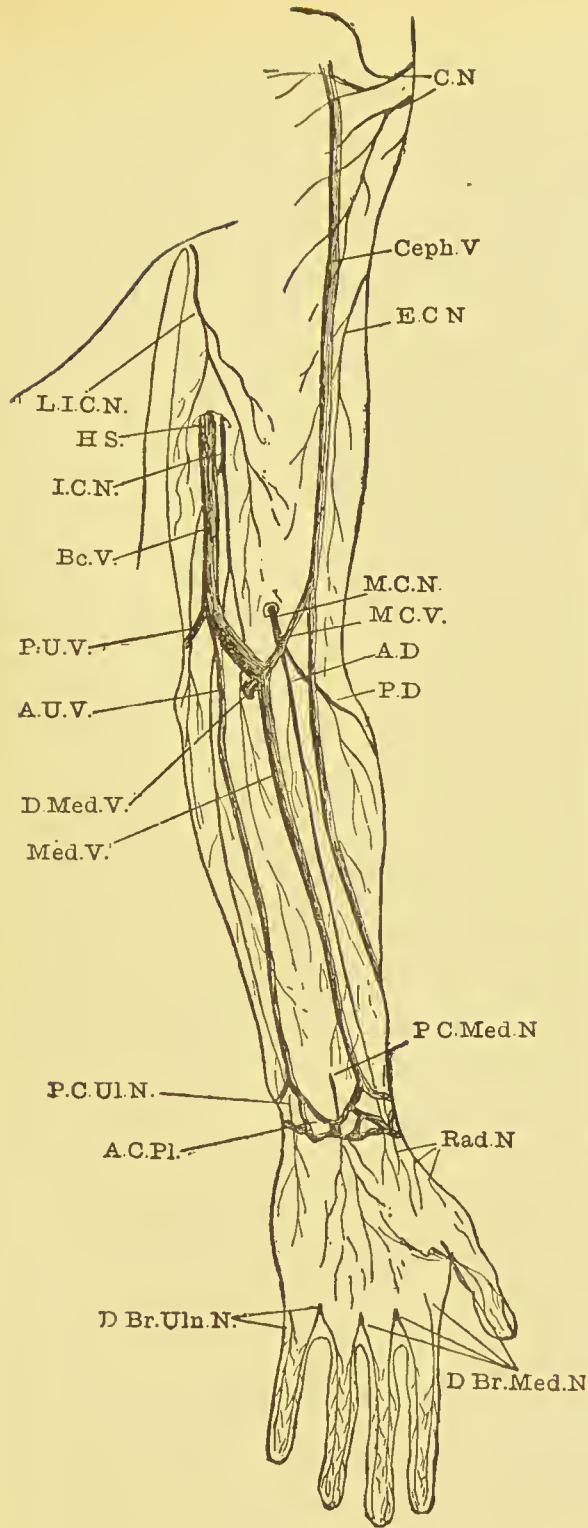


FIG. 300.—SUPERFICIAL DISSECTION OF THE UPPER EXTREMITY.

C.N. Circumflex Nerve. *Ceph. V.* Cephalic Vein. *E.C.N.* Superior External Cutaneous Branch of Musculo-spiral Nerve. *M.C.N.* Point of Exit of Musculo-cutaneous Nerve. *A.D.* and *P.D.* Its Anterior and Posterior Divisions. *M.C.V.* Median Cephalic Vein. *P.C.Med.N.* Palmar Cutaneous Branch of Median Nerve. *Rad.N.* Radial Nerve. *D.Br.Uln.N.* Digital Branches of Ulnar Nerve. *A.C.Pl.* Anterior Carpal Venous Plexus. *P.C.Uln.N.* Palmar Cutaneous Branch of Ulnar Nerve. *Med.V.* Median Vein. *D.Med.V.* Deep Median Vein. *A.U.V.* Anterior Ulnar Vein. *P.U.V.* Posterior Ulnar Vein. *Bc.V.* Basilic Vein. *I.C.N.* Internal Cutaneous Nerve. *L.I.C.N.* Lesser Internal Cutaneous Nerve. *H.S.* Hiatus Semilunaris.

That swelling in the upper part of the arm which is nearest the axilla is the long head.

The external head has very short, fleshy fibres, and lies below the lower half of the posterior border of the deltoid. If the living arm is extended and rotated inwards, the oblique, roll-like swelling of this head will be readily felt. It is an important landmark, because the musculospiral nerve lies deep to it and nearly corresponds to its long axis.

The bony points at the back of the elbow are very important in diagnosing between fractures and dislocations.

The two condyles are easily felt from behind, and if a line is drawn between them it will just touch the top of the olecranon process of the ulna when the elbow is extended. The head of the radius is most easily felt immediately below the back of the external condyle, though while it is being felt for, the forearm should be continuously pronated and supinated. A bursa lies between the olecranon and the skin.

The elbow joint too is easily felt just above the head of the radius, between it and the capitellum of the humerus.

Between the internal condyle and the olecranon passes the ulnar nerve, which is here specially liable to injury, and is popularly known as the "funny bone."

SKIN INCISIONS.—Make a vertical incision down the front of the arm from the place whence the skin has already been reflected to a point an inch below the bend of the elbow. Here make a transverse incision at right angles to the former and reflect the two flaps.

The *superficial structures* are those lying between the skin and the *deep fascia*, which in the arm and forearm really does form a sleeve-like sheath of membrane, though of course this merges insensibly into the cellular tissue, packing up all the interstices between the muscles on its deep surface as well as with the fat-containing superficial fascia between it and the skin.

The *superficial veins* (see Fig. 300) form a free communi-

cation in front of the elbow, which, as has been seen, is liable to considerable variation. As a rule, the blood from the superficial parts of the forearm runs up in a *median*, a *radial* and two *ulnar veins* (anterior and posterior). These are quite apart from the venæ comites of the radial and ulnar arteries. About the lower limit of the dissection the median vein receives a *deep median* piercing the fascia of the forearm and affording a communication between the deep and superficial veins. As soon as these two median veins have joined they bifurcate into the *median basilic*, which runs upwards and inwards, and the *median cephalic*, running upwards and outwards.

These in their turn are joined by the veins from the sides of the forearm, the median basilic by the *anterior* and *posterior ulnar veins*, and the median cephalic by the *radial*. The combined trunk formed by the junction of the median basilic and ulnar veins is continued up as the *basilic*, while that of the median cephalic and radial forms the *cephalic vein* already studied in the shoulder region. A little above the internal condyle in close relation to the ulnar veins are one or two small *epicondylar lymph nodes*, which receive the lymphatics draining the inner side of the hand and forearm.

The *median basilic* is the vein from which patients used to be bled, though when it was small the median cephalic was used; it lies in front of the brachial artery, only separated by the bicipital fascia. In spite of this fascia, clumsy operators frequently established a communication between the vein and the artery, which subsequently caused trouble.

The *basilic vein*, if traced upwards, is seen to gradually pierce the deep fascia about the middle of the arm. Sometimes a definite semilunar opening (*hiatus semilunaris*) is described, but a good deal of artificial work is necessary to demonstrate it satisfactorily. Through it the *internal cutaneous nerve* [n. eutaneus antebraehii medialis] emerges and soon divides into anterior and posterior branches. Of these the anterior runs down, usually deep to the median

basilic vein, though a few twigs pass superficially to it. The posterior branch runs downwards and backwards, gradually crossing deep to the basilic vein.

The *lesser internal cutaneous nerve* [n. cutaneus brachii medialis] should be followed down from the axilla; it will be found to pierce the deep fascia above the middle of the arm and to supply its integument as low as the internal condyle.

The *musculo-cutaneous nerve*, as has been noticed, pierces the deep fascia close to the outer side of the biceps tendon and divides into anterior and posterior branches. Like the internal cutaneous, it usually passes deep to its vein, the median cephalic. On the back of the arm the *internal cutaneous branch of the musculo-spiral* has already been found, and should be followed as far as possible in its distribution.

The *upper external cutaneous branch of the musculo-spiral* appears near the lower part of the posterior border of the deltoid, between it and the triceps, and thenceforward accompanies the cephalic vein to supply the lower half of the outer surface of the arm.

The *lower external cutaneous branch of the musculo-spiral* is a good deal larger than the last, and pierces the deep fascia an inch or two above and behind the external condyle; it runs down behind this condyle, and is distributed to the forearm. Now divide and clear away the deep fascia of the arm within the limits of the skin incisions, and notice that externally and internally *intermuscular septa* run from it to the corresponding supra-condylar ridges. Find the brachial artery [a. profunda brachii] lying in the internal bicipital sulcus, and study its position and relations as well as those of its branches. Since all structures require blood, this proceeding will bring all the important structures of the arm under review.

The *brachial artery* begins at the lower border of the teres major tendon and ends by dividing into the radial and ulnar arteries about half an inch below the elbow joint, and

the crease which indicates the position of this at the bend of the elbow.

The artery never really touches the humerus, but is only separated from it by such a thickness of muscle that it can be compressed against the bone by deep pressure. Notice that in the upper part of its course this pressure must be directed from within outwards to be effective, while lower down it has to be directed from before backwards.

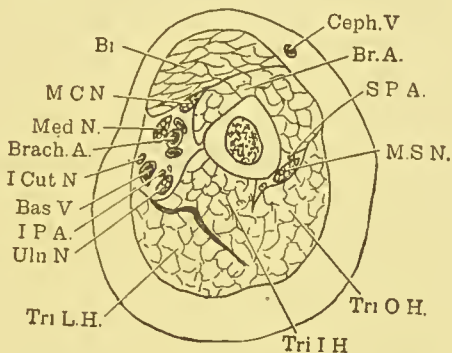


FIG. 301.—SECTION THROUGH THE MIDDLE OF THE RIGHT ARM.

Bi. Biceps. *Ceph.V.* Cephalic Vein. *Br.A.* Brachialis Anticus. *M.C.N.* Musculo-cutaneous Nerve. *S.P.A.* Superior Profunda Artery. *M.S.N.* Musculo-spiral Nerve. *Tri.O.H.* Outer Head of Triceps. *Tri.I.H.* Inner Head of Triceps. *Tri.L.H.* Long Head of Triceps. *Uln.N.* Ulnar Nerve. *I.P.A.* Inferior Profunda Artery. *Bas.V.* Basilic Vein. *I.Cut.N.* Internal Cutaneous Nerve. *Brach.A.* Brachial Artery. *Med.N.* Median Nerve.

The anterior relations of the artery are:—

Bones.—None.

Muscles.—The inner edge of the biceps which overlaps it, and is the point which the surgeon seeks first in exposing the artery for ligature.

Fibrous Structures.—The deep fascia of the arm and the bicipital fascia.

Arteries.—None.

Veins.—Median basilic separated by the bicipital fascia. Cross communications between the two venæ comites.

Nerves.—Median in the middle of the arm.

Glandular and other Structures.—Antecubital lymphatics.

The *Biceps muscle* rises by two heads, of which the long one is intraeapsular for some distance, and will be examined when the shoulder joint is dissected. It appears as a roundish tendon lying in the bieipital groove. Replace the pectoralis major superficial to it, and notice that as soon as it is clear of the lower edge of this it swells out into a fusiform, fleshy belly. The short head rises from the tip of the coracoid process in common with the origin of the coracobrachialis, but they may be distinguished easily, because the biceps is external and tendinous while the coraeo-brachialis is internal and fleshy. The two bellies of the biceps fuse about the middle of the arm, and, lower down, converge into a flattened tapering tendon, the borders of which are at first lateral, and then antero-posterior; it is inserted into the back of the tubercle of the radius.

Pronate the forearm so that the palm of the hand lies on the table, and then pull on the biceps. The first result will be that the forearm will untwist or supinate, and then the elbow joint will flex. As the muscle also passes in front of the shoulder joint, it will flex that as well.

The *bicipital* or *semilunar fascia* [lacertus fibrosus] runs from the inner side of the biceps tendon downwards and inwards to the deep fascia of the forearm superficial to the origin of the superficial flexors of the forearm.

The *Median nerve* was traced as far as the outer side of the end of the axillary artery, and is therefore external to the beginning of the brachial, but about the middle of the arm the nerve crosses in front of (occasionally behind) the artery, and so becomes internal below.

As a rule, no branches are given off in the arm.

The *antecubital lymphatic nodes* are one or two nodes which lie in the antecubital fossa or triangular space in front of the elbow. They lie close to the artery, but require the most careful search.

The posterior relations of the brachial artery are :—

Bones.—The humerus, as has been seen, is never a direct relation, but is near enough to allow the artery to be compressed against it.

Muscles.—The long and inner heads of the triceps, the coraco-brachialis, and the brachialis-anticus.

Fibrous Structures.—None.

Arteries.—Superior profunda.

Veins.—Superior profunda venæ comites.

Nerves.—Musculo-spiral.

Glandular and other Structures.—None.

The Triceps muscle has, as its name implies, three heads. The long head rises from the axillary border of the scapula, just below the glenoid cavity. The outer head rises by a nearly vertical linear origin from the posterior surface of the humerus above the spiral groove.

The inner head rises from the posterior surface of the humerus below and internal to the spiral groove, and its origin reaches right down to the back of the external condyle. Here the *Anconeus*, really a part of the triceps, continues the origin and runs across to the outer side of the olecranon process.

The insertion of the triceps is into the back part of the upper surface of the olecranon process of the ulna.

The *musculo-spiral nerve* [n. radialis] lies at first between the brachial artery in front and the long head of the triceps behind, accompanied by the superior profunda artery. Cut the long head of the triceps and turn it down, looking carefully for the twig supplying it; then trace the nerve to the spiral groove of the humerus between the outer and inner heads of the triceps. Once in the groove the nerve is covered by the outer head of the triceps, and this should now be divided by an incision passing obliquely downwards and outwards at right angles to the short fleshy fibres of this head. Close to the branch supplying the long head of the triceps will be found the origin of the internal cutaneous

branch of the musculo-spiral, and also branches to the internal head, one of which runs down to the lower part of the muscle, close behind the ulnar nerve, and so is known as the *ulnar collateral branch*.

While the musculo-spiral nerve is deep to the outer head

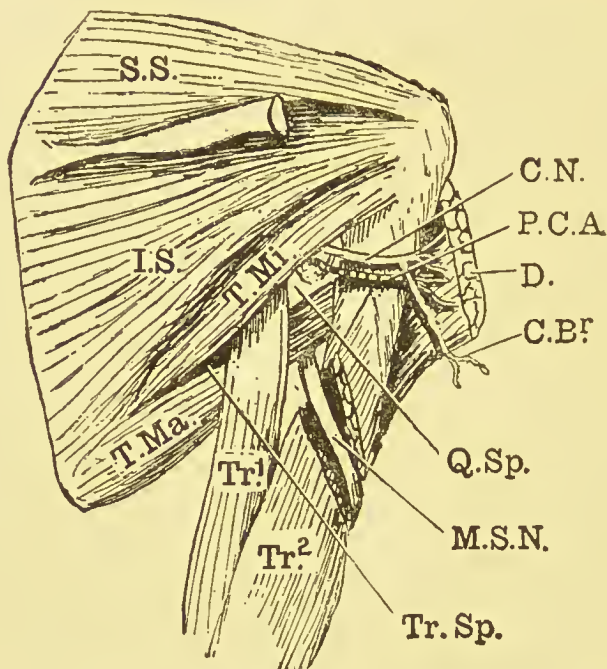


FIG. 302.—DISSECTION OF THE SHOULDER REGION FROM BEHIND.

S.S. Supra-spinatus Muscle. *I.S.* Infra-spinatus. *T.Mi.* Teres Minor. *Te.Ma.* Teres Major. *D.* Deltoid. *C.N.* Circumflex Nerve. *C.Br.* Its Cutaneous Branch. *P.C.A.* Posterior Circumflex Artery. *Q.Sp.* Quadri-lateral Space. *M.S.N.* Musculo-spiral Nerve. *Tr.Sp.* Triangular Space. *Tr*¹. Long Head of Triceps. *Tr*². External Head of Triceps cut.

of the triceps, it gives off twigs to this head and also a long slender branch which runs down in the substance of the inner head, accompanied by a branch of the superior profunda artery, to the outer side of the olecranal process, where it enters the deep surface of the anconeus.

As soon as the musculo-spiral is clear of the outer head of

the triceps it gives off its two external cutaneous branches, already examined; it then pierces the external intermuscular septum, and lies in front of the external supra-condylar ridge between the origins of the brachio-radialis and brachialis anticus muscles, which should be forcibly dragged apart to expose it. Here it gives off twigs to the brachio-radialis, extensor carpi radialis longior, elbow joint, and occasionally to the brachialis anticus, and finally divides into its two terminal branches, the radial [*ramus radialis superficialis*] and posterior interosseous [*ramus radialis profundus*], a little above the level of the external condyle. It will save much future difficulty if the dissector will realise that, at its division, the musculo-spiral sends all its remaining sensory fibres into the radial and all its motor fibres into the posterior interosseous nerve.

The *superior profunda artery* [*a. profunda brachii*] accompanies the musculo-spiral nerve in the spiral groove. When it is well injected it will be found to send a small *descending articular branch* with the nerve to the anconeus down to the anastomosis above the olecranon. The end of the superior profunda may sometimes be seen to anastomose with the radial recurrent artery in front of the external condyle.

The *coraco-brachialis* muscle rises, in common with the short head of the biceps, from the tip of the coracoid process. The contrast between its fleshy origin and the tendinous one of the biceps has already been noticed. The insertion is into the inner surface of the humerus, just above its middle and close to its inner border. Notice that the muscle is pierced obliquely by the musculo-cutaneous nerve.

From the insertion of the coraco-brachialis, and therefore very close behind the brachial artery, the *internal intermuscular septum* begins and runs down to the internal condyle. It is attached to the internal supra-condylar ridge all the way, and separates the triceps from the brachialis

anticus. Some of its fibres may usually be traced into the insertion of the coraco-brachialis.

The *brachialis anticus* rises from the lower half of the outer and inner surfaces of the humerus, and the deltoid insertion is seen to dovetail into this origin. Trace the muscle upwards on the outer side of the deltoid, and notice that here it is really rising from the lower end of the spiral groove. Externally its origin is so closely blended with that of the brachio-radialis that the two muscles have to be forcibly separated in order to expose the musculo-spiral nerve which lies between them.

The brachialis anticus forms a thick fleshy mass in front of the elbow joint, and here is remarkable for its vertically striped appearance caused by alternate streaks of flesh and tendon. If, in tying the brachial artery at the elbow, this appearance is seen, it shows the operator that he has reached too deep a level.

The insertion into the front of the coronoid process of the ulna cannot very well be made out now, but it is quite obvious that the muscle can only act as a flexor of the elbow joint, since flexion and extension are the only movements allowed between the humerus and ulna.

While the brachialis anticus is being examined will be a good time to clean and follow the *musculo-cutaneous nerve*. Pick it up as it comes out of the outer side of the coraco-brachialis, and notice that it is now lying deep to the biceps and superficial to the brachialis anticus.

Here it gives off motor twigs to both heads of the biceps, and usually two to the brachialis anticus, from one of which the chief articular nerve to the elbow is derived. It now has nothing but cutaneous fibres left, and as soon as it reaches the outer side of the tendon of the biceps, it pierces the fascia and becomes superficial.

Sometimes a communication with the median is found deep to the biceps.

The external relations of the brachial artery are:—

Muscles.—Coraco-brachialis above, brachialis anticus, biceps and brachio-radialis below.

Veins.—External vena comes.

Nerves.—Median above.

All these structures have been examined except the *brachio-radialis*, which here is forming the outer boundary of the antecubital fossa.

The internal relations of the brachial artery are:—

Muscles.—Pronator radii teres.

Fibrous Structures.—Deep fascia of arm.

Arteries.—The origins of its branches, the inferior profunda and anastomotica magna arteries.

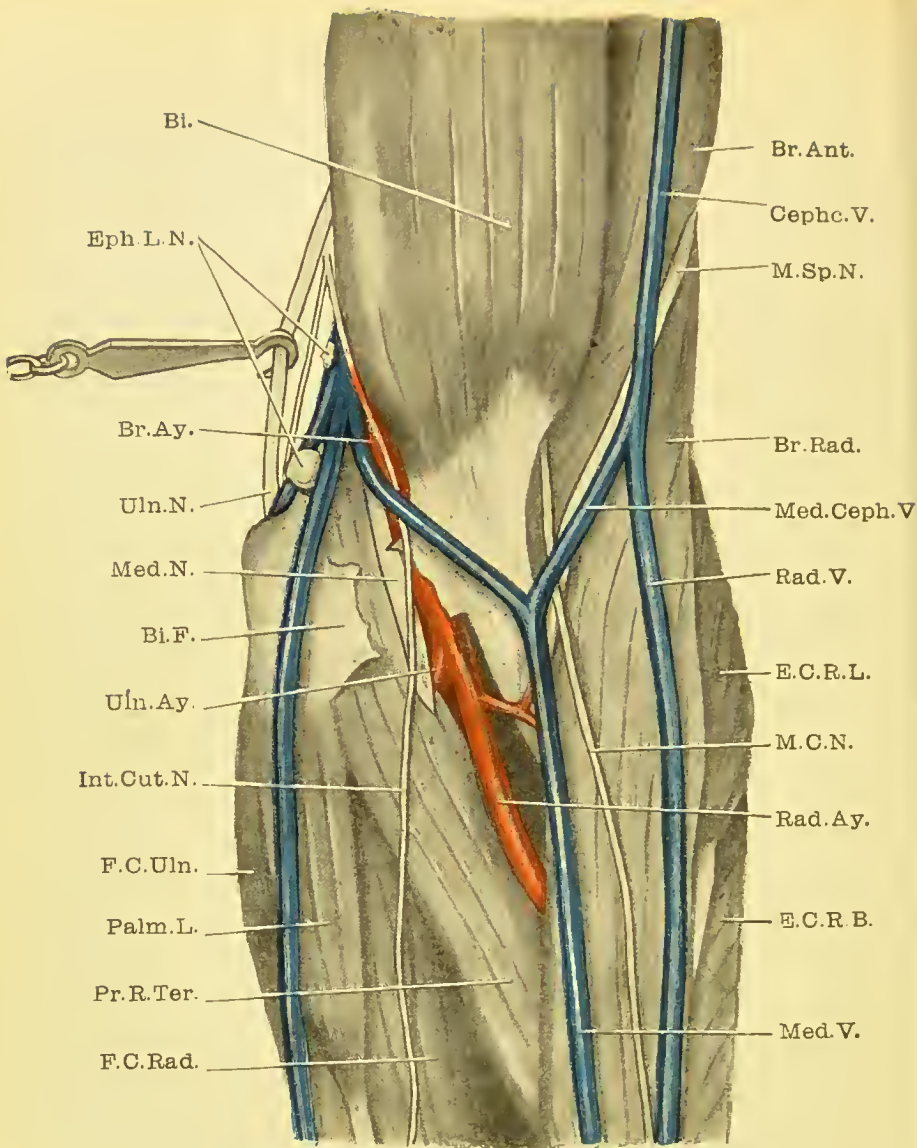
Veins.—Basilic and the internal vena comes.

Nerves.—Ulnar and internal cutaneous above and median below.

The *pronator radii teres* is here forming the inner boundary of the antecubital fossa, the relations and contents of which may now be reviewed.

The *antecubital fossa* is a triangular space situated in front of the elbow, and having its apex directed downwards. Its base is an imaginary horizontal line drawn from just above one condyle to just above the other; its outer side is the brachio-radialis, its inner the pronator radii teres, while its floor is the brachialis anticus. In this space the tendon of the biceps runs vertically down, having the brachial artery and venæ comites on its inner side and the median nerve still more internal. On the outer side of the biceps the end of the musculo-spiral nerve is hidden by the coalesced brachialis anticus and brachio-radialis; it divides into its two terminal branches the radial and posterior interosseous, while superficial to the termination of the artery are the antecubital lymphatic nodes.

Ulnar Nerve.—Trace this down from where it was left in the axilla, and notice how close it lies to the inner side of the brachial artery until the middle of the arm is reached; then



F.C.C.

FIG. 303.—DISSECTION OF THE ELBOW REGION FROM IN FRONT.

Br.Ant. Branchialis Anticus. *M.Sp.N.* Musculo-spiral Nerve. *Br.Rad.* Brachio-radialis. *Med.Ceph V.* Median Cephalic Vein. *Rad.V.* Radial Vein. *E.C.R.L.* Extensor Carpi Radialis Longior. *M.C.N.* Musculo-cutaneous Nerve. *Rad.Ay.* Radial Artery. *E.C.R.B.* Extensor Carpi Radialis Brevior. *Med.V.* Median Vein. *F.C.Rad.* Flexor Carpi Radialis. *Pr.R.Ter.* Pronator Radii Teres. *Palm.L.* Palmaris Longus. *F.C.Uln.* Flexor Carpi Ulnaris. *Int.Cut.N.* Internal Cutaneous Nerve. *Uln.Ay.* Ulnar Artery. *Bi.F.* Bicipital Fascia. *Med.N.* Median Nerve. *Uln.N.* Ulnar Nerve. *Br.Ay.* Brachial Artery. *Ep.L.N.* Epicondylar Lymph Nodes. *Bi.* Biceps.

it runs backwards and inwards a little, passing behind the internal intermuscular septum, accompanied by the inferior profunda artery, to gain the hollow between the internal condyle and the olecranon. Here it disappears between the two heads of the flexor carpi ulnaris muscle. The ulnar

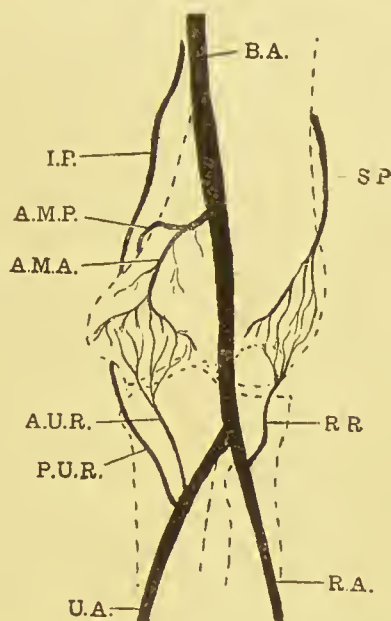


FIG. 304.—DIAGRAM OF THE ARTERIAL ANASTOMOSIS IN FRONT OF THE ELBOW.

B.A. Brachial Artery. *I.P.* Inferior Profunda. *A.M.P.* Posterior Branch of Anastomotica Magna. *A.M.A.* Anterior Branch of Anastomotica Magna. *S.P.* Superior Profunda. *R.R.* Radial Recurrent. *A.U.R.* Anterior Ulnar Recurrent. *P.U.R.* Posterior Ulnar Recurrent. *R.A.* Radial Artery. *U.A.* Ulnar Artery.

nerve gives off no branches in the arm, but as it passes the elbow some minute twigs may be found going into the joint.

The *branches of the brachial artery* are the superior profunda, inferior profunda, nutrient and muscular and the anastomotica magna.

The superior profunda has been followed already (see p. 291).

The *inferior profunda* [a. collateralis ulnaris superior] comes off the inner side of the brachial, usually a little lower than the superior, and accompanies the ulnar nerve down the inner side of the arm behind the internal intermuscular septum.

The *nutrient branch* may be found by remembering that the nutrient foramen of the humerus is generally situated on the internal surface a little below the insertion of the coraco-

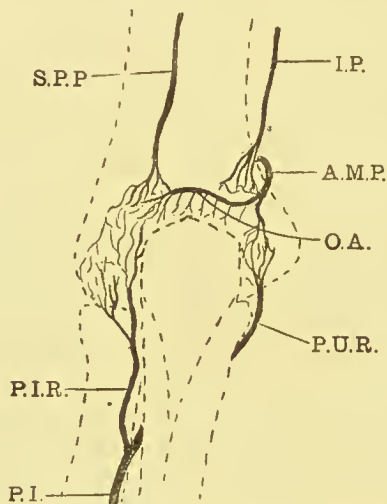


FIG. 305.—DIAGRAM OF THE ARTERIAL ANASTOMOSIS BEHIND THE ELBOW.

S.P.P. Posterior Branch of Superior Profunda. *I.P.* Inferior Profunda. *A.M.P.* Posterior Branch of Anastomotica Magna. *O.A.* Arch above Olecranal Fossa. *P.U.R.* Posterior Ulnar Recurrent. *P.I.R.* Posterior Interosseous Recurrent. *P.I.* Posterior Interosseous.

brachialis. Carefully follow the branches in the brachialis anticus in this region, when one of them will be seen entering the bone.

The *anastomotica magna* [a. collateralis ulnaris inferior] comes off the inner side of the brachial about two inches above the internal condyle. Follow it inwards to the internal intermuscular septum, where it divides into anterior and posterior branches. The posterior branch pierces the

septum, and should be traced round the back of the humerus as a vascular arch deep to the triceps tendon, and a little above the attachment of the posterior part of the capsule of the elbow. The anterior branch, when well injected, may be followed down in front of the internal condyle, where it anastomoses with the anterior ulnar recurrent artery.

A fairly common abnormality of the brachial artery is a high division into radial and ulnar. It is met with often enough to be of direct practical interest to the surgeon. A high radial is more frequent than a high ulnar, and if there is any doubt as to which is the high branch, the origin of the common interosseous is a test, for this always rises from the main arterial stem.

THE FRONT OF THE FOREARM

SKIN INCISIONS.—The surface anatomy is so easily studied on the dissector's own forearm that the most practical method is to display the superficial structures on the "part," and then to notice their position and surface markings on the living forearm. Make a vertical incision down the middle of the front of the forearm as far as the lower crease in front of the wrist. Then make a transverse incision along this crease and reflect the two flaps of skin.

SUPERFICIAL STRUCTURES.—*The anterior branch of the musculo-cutaneous nerve* should be followed down as far as the lower end of the exposed area, whence it passes on to the ball of the thumb. It gives off numerous twigs supplying the radial side of the front of the forearm.

The anterior branch of the internal cutaneous nerve should be followed on from where it was left in the arm. It will be found to supply the inner side of the front of the forearm; but it does not reach the hand as the external cutaneous does. Sometimes a superficial branch of the ulnar nerve pierces the deep fascia on the inner side of the forearm and communicates with the internal cutaneous.

The *palmar cutaneous branch of the median nerve* should be looked for in the lower part of the exposed area in the interval between the tendons of the flexor carpi radialis and palmaris longus, the two tendons which stand out so prominently in the living forearm just above the wrist when that joint is forcibly flexed.

The *palmar cutaneous branch of the ulnar nerve* is smaller than that of the median and pierces the deep fascia a little above and external to the pisiform bone, which is so easily felt through the skin on the inner side of the front of the wrist.

The *superficial veins of the front of the forearm* are the radial, the median, and the anterior ulnar.

The *radial vein* winds round the outer side of the forearm from the back of the wrist, while the *median* and *ulnar veins* begin in a plexus in front of the wrist. The course of these superficial veins is easily seen in the living forearm, while in the dissection it will be noticed that they lie superficial to the nerve trunks and are only crossed by very small cutaneous nerve twigs.

Now remove the deep fascia of the forearm, beginning from below. As the upper part is approached it will be more and more difficult to remove, because the underlying muscles rise from it, and where its removal tears these muscles it had better be left untouched.

Identify the superficial muscles of the forearm, beginning with the brachio-radialis on the outer side, rising from the external supra-condylar ridge, and then, in their order from without inwards, the pronator radii teres, flexor carpi radialis, palmaris longus, flexor sublimis digitorum and flexor carpi ulnaris. All these last five rise, in part at least, from the internal condyle, and their fleshy bellies cause the rounded thickening of the upper half of the forearm.

In its lower half, where they become tendinous, the forearm is a good deal more slender.

Bear in mind that the palmaris longus is an inconstant muscle and is often wanting.

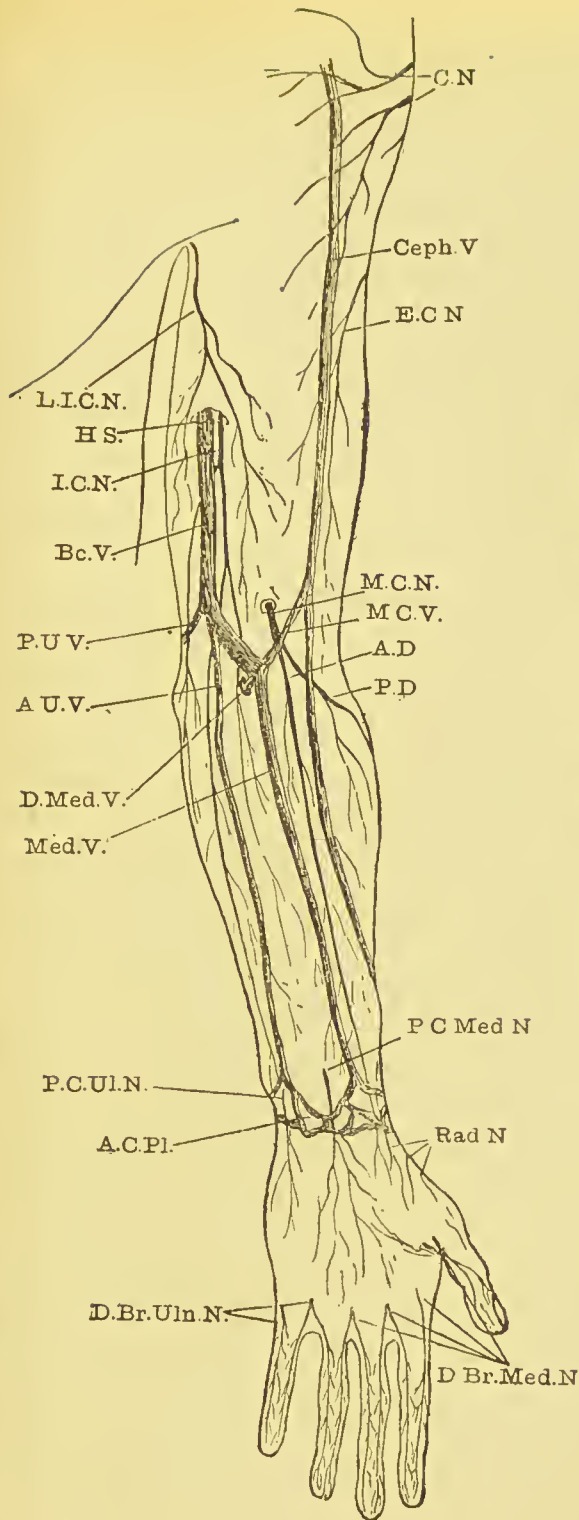


FIG. 306.—SUPERFICIAL DISSECTION OF THE UPPER EXTREMITY.

C.N. Circumflex Nerve. *Ceph. V.* Cephalic Vein. *E.C.N.* Superior External Cutaneous Branch of Musculo-spiral Nerve. *M.C.N.* Point of Exit of Musculo-cutaneous Nerve. *A.D.* and *P.D.* Its Anterior and Posterior Divisions. *M.C.V.* Median Cephalic Vein. *P.C.Med.N.* Palmar Cutaneous Branch of Median Nerve. *Rad.N.* Radial Nerve. *D.Br.Med.N.* Digital Branches of Median Nerve. *D.Br.Uln.N.* Digital Branches of Ulnar Nerve. *A.C.Pl.* Anterior Carpal Venous Plexus. *P.C.Uln.N.* Palmar Cutaneous Branch of Ulnar Nerve. *Med.V.* Median Vein. *D.Med.V.* Deep Median Vein. *A.U.V.* Anterior Ulnar Vein. *P.U.V.* Posterior Ulnar Vein. *Ec.V.* Basilic Vein. *I.C.N.* Internal Cutaneous Nerve. *L.I.C.N.* Lesser Internal Cutaneous Nerve. *H.S.* Hiatus Semilunaris.

DISSECTION OF THE FRONT OF THE FOREARM

Follow the arteries of the front of the forearm, examining in detail all the structures with which they and their branches are in contact.

The bifurcation of the brachial artery was seen in the ante-cubital space on a level with the neck of the radius.

In the living this point may be fixed by taking the middle of the antecubital triangle, just internal to the biceps tendon, and a finger's-breadth below the bend of the elbow.

The *radial artery* is more superficial than the ulnar, and runs down to the front of the wrist, where it lies just on the outer side of the flexor carpi radialis tendon. Here it is so superficial that its pulsations are easily felt during life, and in addition to this the softness and elasticity of its coats may be determined by any one with sufficient experience. The surface marking of the artery is not a straight line from the bifurcation of the brachial artery to the radial side of the flexor carpi radialis at the wrist, but one with a slight convexity outwards.

The *anterior relations of the radial artery in the forearm* are:—

Muscles.—Brachio-radialis.

Fibrous Structures.—Deep fascia of forearm.

Vessels and Nerves.—The radial vein and external cutaneous nerve separated from the artery by the deep fascia.

The origin of the *brachio-radialis* (or supinator longus) has already been seen; notice how, as it descends, it is wrapped inwards on to the front of the forearm. About half-way down the forearm it becomes tendinous, and the tendon, as it runs down, reverts to the outer side of the forearm and is inserted into the outer side of the lower end (epiphysis) of the radius at the root of the styloid process.

The only action of the brachio-radialis worthy of mention is that of a flexor of the elbow. A glance at the left forearm

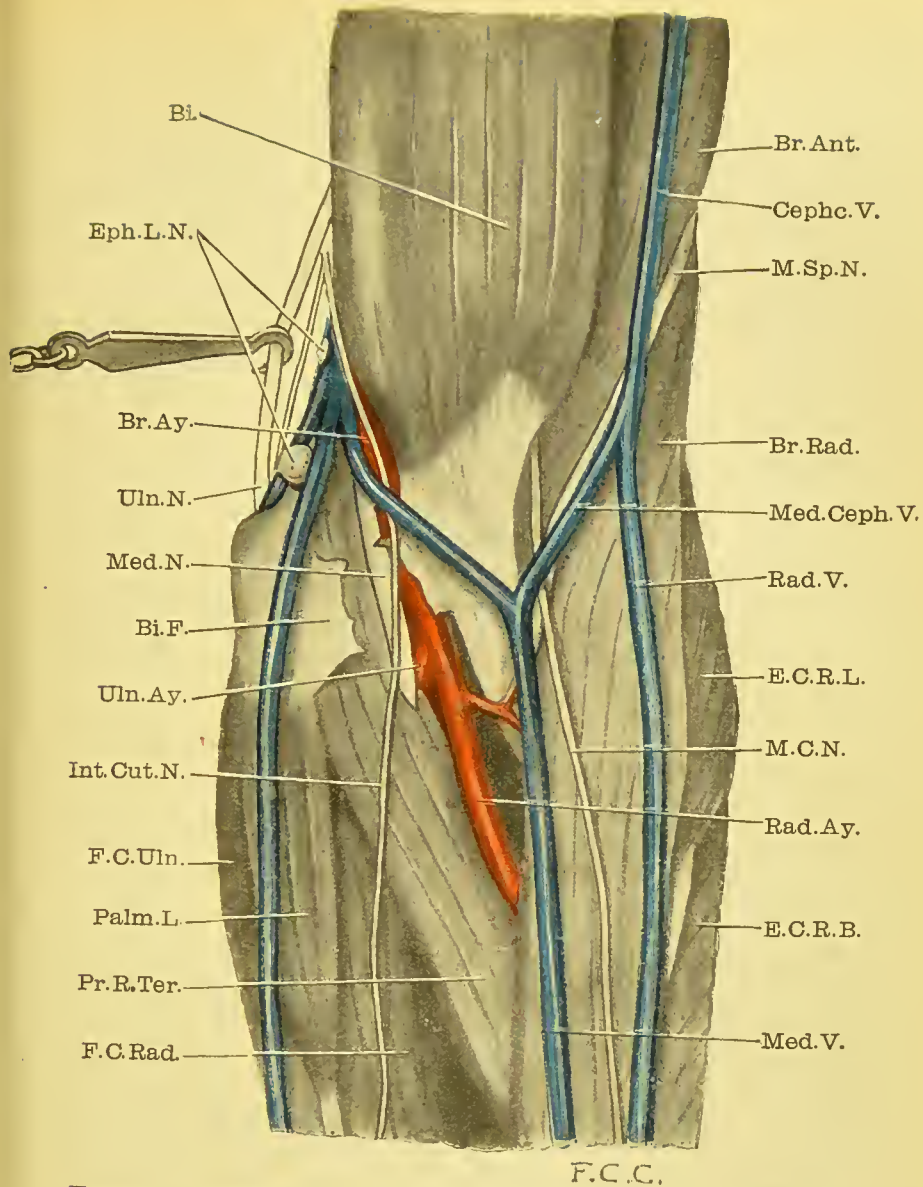


FIG. 307.—DISSECTION OF THE ELBOW REGION FROM IN FRONT.

Br. Ant. Brachialis Anticus. *M. Sp. N.* Musculo-spiral Nerve. *Br. Rad.* Brachio-radialis. *Med. Ceph. V.* Median Cephalic Vein. *Rad. V.* Radial Vein. *E. C. R. L.* Extensor Carpi Radialis Longior. *M. C. N.* Musculo-cutaneous Nerve. *Rad. Ay.* Radial Artery. *E. C. R. B.* Extensor Carpi Radialis Brevior. *Med. V.* Median Vein. *F. C. Rad.* Flexor Carpi Radialis. *Pr. R. Ter.* Pronator Radii Teres. *Palm. L.* Palmaris Longus. *F. C. Uln.* Flexor Carpi Ulnaris. *Int. Cut. N.* Internal Cutaneous Nerve. *Uln. Ay.* Ulnar Artery. *Bi. F.* Bicipital Fascia. *Med. N.* Median Nerve. *Uln. N.* Ulnar Nerve. *Br. Ay.* Brachial Artery. *Ep. L. N.* Epicondylar Lymph Nodes. *Bi.* Biceps.

of a man digging shows its action at once. Its nerve supply from the musculo-spiral has been made out already.

The *external relations of the radial artery in the forearm* are the brachio-radialis all the way, its outer vena comes, and the radial nerve in the middle third of the forearm.

Turn the brachio-radialis outwards, and follow the *radial*

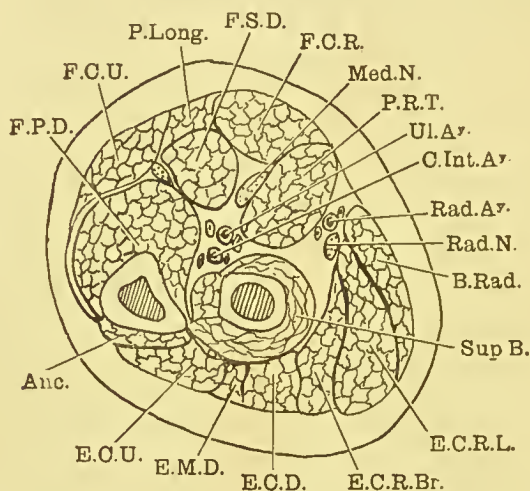


FIG. 308.—SECTION OF THE RIGHT FOREARM AT THE JUNCTION OF THE UPPER AND MIDDLE THIRDS.

F.C.R. Flexor Carpi Radialis. *Med.N.* Median Nerve. *P.R.T.* Pronator Radii Teres. *UL.Ar.* Ulnar Artery. *C.Int.Ar.* Common Interosseous Artery. *Rad.Ar.* Radial Artery. *Rad.N.* Radial Nerve. *B.Rad.* Brachio-radialis. *Sup.B.* Supinator Brevis. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.Br.* Extensor Carpi Radialis Brevior. *E.C.D.* Extensor Communis Digitorum. *E.M.D.* Extensor Minimi Digiti. *E.C.U.* Extensor Carpi Ulnaris. *Anc.* Anconeus. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris (deep to this is the Ulnar Nerve). *P.Long.* Palmaris Longus. *F.S.D.* Flexor Sublimis Digitorum.

nerve down from the bifurcation of the musculo-spiral nerve. Its course in the living may be marked out by drawing a line from the front of the external condyle to the front of the styloid process of the radius, and taking the upper two-thirds of this line as a guide. Trace it in front of the outer part of the elbow joint on to the front of the supinator brevis muscle.

As soon as it reaches the lower border of this, the radial artery meets it at an acute angle, and the two run side by side (the nerve being external) as far as the junction of the middle and lower thirds of the forearm. Here the nerve leaves the artery and runs backwards, deep to the tendon of the brachio-radialis, to the dorsal aspect of the forearm. Notice that in the whole of this course it gives off no branches.

The *internal relations of the radial artery in the forearm* are only the pronator radii teres above, the flexor carpi radialis below, and the internal vena comes all the way.

The *pronator radii teres* rises from the internal condyle and slightly from the internal supra-condylar ridge; it also rises, like all the other superficial flexor muscles, from the deep fascia covering it. It has in addition a small, deep head, which will be seen better a little later on. Follow the muscle obliquely downwards and outwards, as the inner boundary of the antecubital triangle, till it reaches the inner margin of the brachio-radialis. Here it passes deep to that muscle and to the radial artery, and, becoming tendinous, is inserted into the middle third of the outer surface of the radius, at the point where the bone reaches its greatest outward convexity. This enables it to pronate the radius with greater force, but, since it passes in front of the elbow, it is also a flexor of that joint. Be very careful in following its upper border to look for the twig which the median nerve gives to it; this enters the muscle rather deeply.

The *flexor carpi radialis muscle* lies on the inner side of the pronator radii teres, between it and the palmaris longus. It has the same origin as the pronator, except that it does not come from the supra-condylar ridge, nor has it any deep head. Notice that the origin of the flexor carpi radialis cannot be separated from that of its neighbours, since they rise from the side of fibrous *intermuscular septa*. While close to the internal condyle the origin of all this superficial

flexor group is inseparably blended into a *common flexor tendon*.

As the tendon of insertion approaches the wrist it lies only a little way to the outer side of the middle line of the front of the forearm, and its outer border acts as a guide

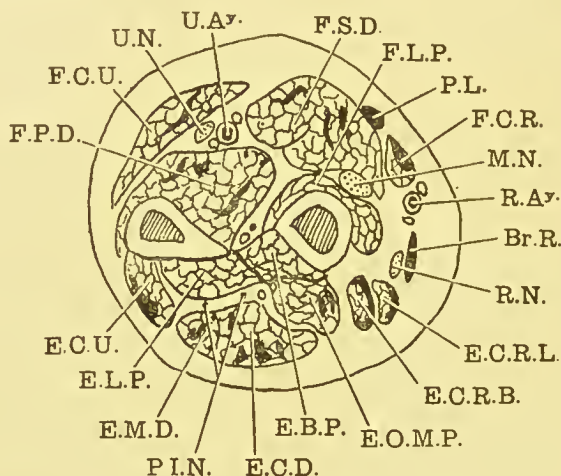


FIG. 309.—SECTION THROUGH THE RIGHT FOREARM AT THE JUNCTION OF THE MIDDLE AND LOWER THIRDS.

(Tendinous parts are black.)

F.S.D. Flexor Sublimis Digitorum. *F.L.P.* Flexor Longus Pollicis. *P.L.* Palmaris Longus. *F.C.R.* Flexor Carpi Radialis. *M.N.* Median Nerve. *R.Ar.* Radial Artery. *Br.R.* Brachio-radialis. *R.N.* Radial Nerve. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.B.* Extensor Carpi Radialis Brevior. *E.O.M.P.* Extensor Ossis Metacarpi Pollicis. *E.B.P.* Extensor Brevis Pollicis. *E.C.D.* Extensor Communis Digitorum. *P.I.N.* Posterior Interosseous Nerve. *E.M.D.* Extensor Minimi Digiti. *E.L.P.* Extensor Longus Pollicis. *E.C.U.* Extensor Carpi Ulnaris. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris. *U.N.* Ulnar Nerve. *U.Ar.* Ulnar Artery.

to the radial artery, while its inner border corresponds to the position of the median nerve, and, as has been seen, has the palmar cutaneous branch of this nerve emerging between it and the palmaris longus (see Fig. 310).

The *palmaris longus*, although not a direct relation of the radial artery, may be conveniently examined now. Its origin

is practically the same as that of the flexor carpi radialis, though its fleshy belly is not so well marked, while its tendon is very long and delicate. This muscle is often absent, and, like all disappearing structures, liable to considerable variations.

The *posterior* or *deep relations of the radial artery in the forearm* are:—

Bones.—The lower end of the radius.

Muscles.—Tendon of biceps, supinator brevis, insertion of pronator radii teres, radial head of flexor sublimis digitorum, flexor longus pollicis, pronator quadratus.

Other Structures.—None.

The *Tendon of the biceps* should now be followed to its insertion into the back part of the tubercle of the radius. Notice that in the radius the tubercle is the point of greatest inward convexity of the bone, so that this powerful supinator acts at a mechanical advantage by attaching itself here, just as the pronator teres does by being inserted into the greatest outward convexity. A further and better chance of observing this insertion will come when the bones are cleared for the dissection of the joints.

The supinator brevis is at present so much hidden by the brachio-radialis and extensor tendons that its study is best deferred until these are removed.

The *flexor sublimis digitorum* lies on a deeper plane than the other superficial flexors, so that, in order to get a good view of it, the flexor carpi radialis and palmaris longus should be cut through about the middle of their fleshy bellies and their two ends reflected.

It will now be possible to trace the origin of the muscle (1) from the common flexor tendon rising from the internal condyle; (2) from the intermuscular septa between it and the other superficial flexor muscles; (3) from the deep fascia overlying it, though this, on account of its comparative depth, is only a slight origin; (4) from the internal lateral ligament of the elbow joint, which conducts it to (5) the sublime tubercle on the inner side of the coronoid process

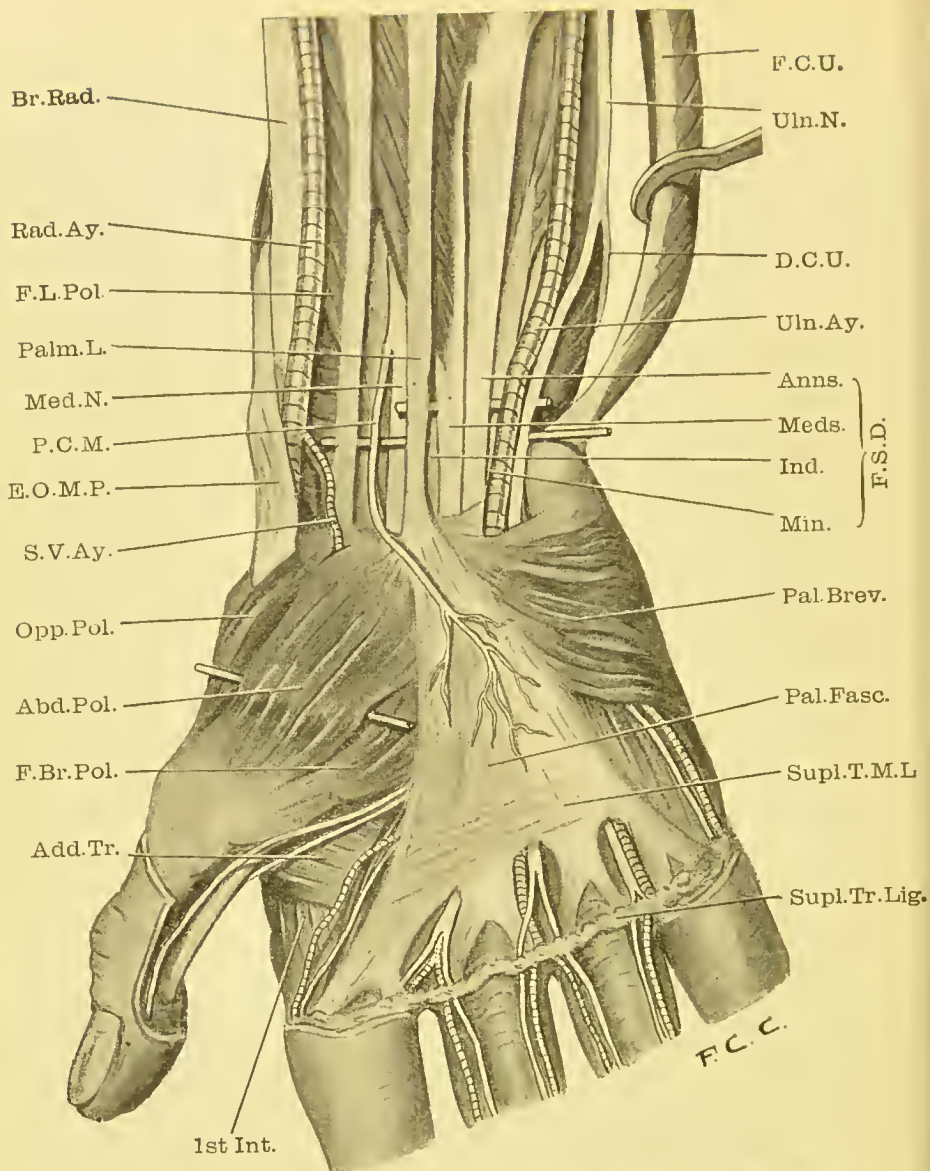


FIG. 310.—SUPERFICIAL DISSECTION OF THE LOWER PART OF THE FOREARM AND OF THE HAND FROM IN FRONT.

F.C.U. Flexor Carpi Ulnaris. *Uln.N.* Ulnar Nerve. *D.C.U.* Dorsal Cutaneous Branch of Ulnar Nerve. *Uln.Ay.* Ulnar Artery. *F.S.D.* Flexor Sublimis Digitorum showing Tendons to the Index, Medius, Annularis, and Minimum Fingers. *Pal.Brev.* Palmaris Brevis. *Pal.Fasc.* Middle Part of Palmar Fascia. *Supl.T.M.L.* Superficial Transverse Metacarpal Ligament. *Supl.Tr.Lig.* Superficial Transverse Ligament. *Br.Rad.* Brachio-radialis. *Rad.Ay.* Radial Artery. *F.L.Pol.* Flexor Longus Pollicis. *Palm.L.* Palmaris Longus. *Med.N.* Median

Nerve. *P.C.M.* Palmar Cutaneous of Median. Just external to this is the Tendon of the Flexor Carpi Radialis. *E.O.M.P.* Extensor Ossis Metacarpi Pollicis. *S.V.Ar.* Superficialis Volæ Artery. *Opp.Pol.* Opponens Pollicis. *Abd.Pol.* Abductor Pollicis. *F.Br.Pol.* Flexor Brevis Pollicis. *Add.Tr.* Adductor Transversus. *1st Int.* 1st Dorsal Interosseus Muscle.

of the ulna; (6) from the oblique line of the radius by a separate thin sheet, which sometimes is very feebly marked. As the wrist is approached, the muscle divides into four tendons, of which those going to the middle and ring fingers are superficial, while those to the index and little fingers are deep (see Fig. 310). Pull the different tendons to realise on which fingers they act, and notice that the radial origin goes only to the outer superficial tendon, that is, the one to the middle finger.

The *flexor longus pollicis* is partly hidden by the radial head of the last muscle. This may be divided and turned aside, but it is better to sketch the undisturbed parts before doing so. The muscle rises from the middle third of the anterior surface of the shaft of the radius, and a little above the wrist becomes tendinous, its tendon lying deep to that of the flexor carpi radialis. Experience has taught us how often these two tendons are mistaken for one another by students, especially when the whole length of the muscles is not exposed, and we would advise very careful observation of their relative positions.

The branches of the radial artery are (1) radial recurrent; (2) muscular; (3) ant. radial carpal; and (4) superficial volar.

The *radial recurrent artery* comes off in the antecubital fossa close to the origin of the radial artery; it should be traced up, deep to the brachio-radialis and superficial to the supinator brevis, in front of the external condyle, where it is in close relation with the end of the musculo-spiral nerve. It supplies the surrounding muscles, and sometimes an anastomosis between it and the superior profunda artery is seen. This, of course, is an important path for collateral circulation when the brachial artery is ligatured (see Fig. 304).

The *anterior radial carpal* [ramus carpeus volaris] runs

deeply to the flexor longus pollicis tendon, and will be seen better later on.

The *superficial volar artery* [ramus volaris superficialis] comes off just above the wrist, and runs to the muscles of the ball of the thumb (see Fig. 310). It varies greatly in size and also in its depth from the surface. Sometimes it may be seen in the living body pulsating deep to the skin of the front of the wrist.

The *Ulnar artery* is larger than the radial, and has a deeper course. Its beginning is seen in the antecubital fossa, while for some distance above the wrist it is easily exposed, as it is just to the outer side of and somewhat overlapped by the tendon of the flexor carpi ulnaris (see Fig. 310). Between these two parts, however, the artery tunnels deep to all the superficial flexor muscles except the flexor carpi ulnaris, and its course may be marked on the living forearm by taking the point of bifurcation of the brachial—a finger's-breadth below the middle of the bend of the elbow—and drawing a curved line with its convexity inward down to the outer side of the pisiform bone.

Replace the cut superficial head of the pronator radii teres, as well as the flexor carpi radialis and palmaris longus, in order to realise the depth of the artery. Notice, too, that the best way of reaching it in the upper part of the forearm is to follow the intermuscular septum between the flexor carpi ulnaris and the flexor sublimis digitorum (see Fig. 311).

Anterior relations of the ulnar artery in the forearm:—

Muscles.—Pronator radii teres, flexor sublimis digitorum, and, more superficially, the palmaris longus and flexor carpi radialis.

Fibrous Structures.—Deep fascia of forearm.

Veins.—Anterior ulnar, or its tributaries superficial to the deep fascia.

Nerves.—Median, often separated by the deep head of the pronator radii teres. Palmar cutaneous of the ulnar and internal cutaneous nerves.

Trace the deep head of the pronator radii teres to its

origin from a ridge on the inner side of the coronoid process, and note that the median nerve lies between the two heads.

This will be a convenient time to trace *the median nerve in the forearm*. At the bend of the elbow the nerve was left on the inner side of the brachial artery; here one or two twigs pass to the elbow joint, but they need very careful

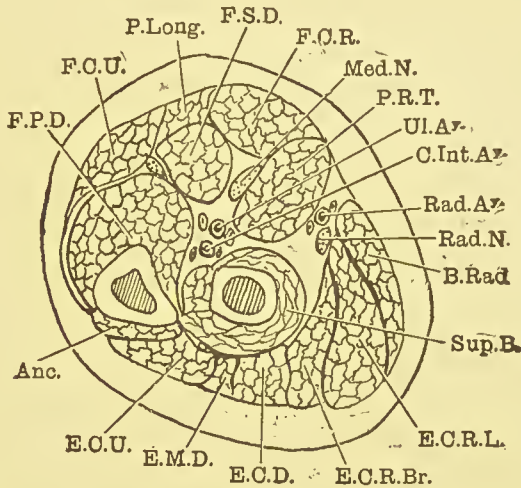


FIG. 311.—SECTION OF THE RIGHT FOREARM AT THE JUNCTION OF THE UPPER AND MIDDLE THIRDS.

F.C.R. Flexor Carpi Radialis. *Med.N.* Median Nerve. *P.R.T.* Pronator Radii Teres. *Ul.Ar.* Ulnar Artery. *C.Int.Ar.* Common Interosseous Artery. *Rad.Ar.* Radial Artery. *Rad.N.* Radial Nerve. *B.Rad.* Brachio-radialis. *Sup.B.* Supinator Brevis. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.Br.* Extensor Carpi Radialis Brevior. *E.C.D.* Extensor Communis Digitorum. *E.M.D.* Extensor Minimi Digiti. *E.C.U.* Extensor Carpi Ulnaris. *Anc.* Anconeus. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris (deep to this is the Ulnar Nerve). *P.Long.* Palmaris Longus. *F.S.D.* Flexor Sublimis Digitorum.

looking for. The twig to the pronator radii teres also comes off about here.

After this the nerves to the flexor carpi radialis, palmaris longus, and flexor sublimis digitorum are easily found. Then comes the point at which the median passes between the two heads of the pronator radii teres and superficial to the ulnar

artery, after which it passes deep to the flexor sublimis digitorum; but as the radial origin of that muscle has been divided, the nerve can be traced all down the forearm by turning the muscle aside. Soon after leaving the pronator radii teres, it gives off the anterior interosseous nerve, and then runs between the flexor sublimis digitorum superficially and the flexor profundus deeply, accompanied by the small median artery (see Fig. 311). As the wrist is approached the palmar cutaneous branch is given off, and the median nerve now winds round the outer side of the four tendons of the flexor sublimis digitorum to become superficial to them in the hand. Where it is winding round the outer side of these tendons is the point at which it lies deep in the interval between the flexor carpi radialis and palmaris longus tendons at the wrist (see Fig. 310).

The *external relations of the ulnar artery in the forearm* are only the flexor sublimis digitorum and the outer vena comes.

The *internal relations of the ulnar artery in the forearm* are at first the flexor sublimis digitorum, but in its lower two-thirds the flexor carpi ulnaris, the ulnar nerve, and the internal vena comes.

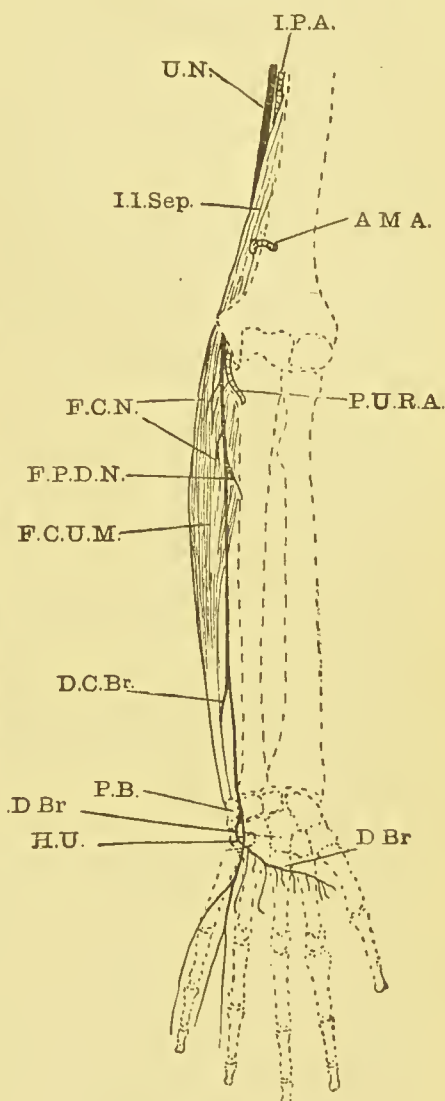
The *flexor carpi ulnaris* rises from the internal condyle, the deep fascia of the forearm and the intermuscular septum between it and the flexor sublimis digitorum. This is its anterior or condylar head [caput humerale]. The posterior or olecranal head [caput ulnare] rises from the inner side of the olecranon and, by a membrane, from the upper two-thirds of the posterior border of the ulna. It gradually becomes tendinous in the lower third of the forearm, and is inserted into the pisiform bone. If the muscle is pulled, it will be found to adduct the wrist, *i.e.* draw the hand towards the mid line of the body when the palm is forward, and also to flex the ulnar side of the wrist.

The *Ulnar nerve in the forearm*.—As the nerve passes between the two origins of the flexor carpi ulnaris, a full view of it may be had by dividing the condylar head and then

separating the flexor carpi ulnaris from the adjacent flexor sublimis digitorum right along the intermuscular septum between them. Now turn the flexor carpi ulnaris inwards, and

FIG. 312.—DIAGRAM OF THE DISTRIBUTION OF THE ULNAR NERVE.

U.N. Ulnar Nerve. *I.P.A.* Inferior Profunda Artery. *I.I.Sep.* Internal Intermuscular Septum. *A.M.A.* Anastomotica Magna Artery (Posterior Branch). *P.U.R.A.* Posterior Ulnar Recurrent Artery. *F.C.N.* Nerves to Flexor Carpi Ulnaris. *F.P.D.N.* Nerve to Flexor Profundus Digitorum. *F.C.U.M.* Flexor Carpi Ulnaris Muscle. *D.C.Br.* Dorsal Cutaneous Branch. *P.B.* Pisiform Bone. *D.Br.* Deep Branch. *H.U.* Hook of Unciform.



the nerve is exposed right down to the pisiform bone. All the way it will be seen to lie superficial to the flexor profundus digitorum, while superficial to it are flexor carpi ulnaris in

the upper two-thirds and deep fascia in the lower third of the forearm. Its relation to the pisiform will possibly be remembered from the fact that it grooves the outer side of that bone, while the fact that it actually grooves the bone shows that it lies on the ulnar or inner side of the ulnar artery. In its course look out for branches to the flexor carpi ulnaris and to the inner half of the flexor profundus digitorum, as well as for its palmar and dorsal cutaneous branches. The latter should be looked for running backwards deep to the flexor carpi ulnaris tendon; the others have been seen already (see Fig. 312).

The *posterior or deep relations of the ulnar artery in the forearm* are only the brachialis anticus and the flexor profundus digitorum.

The *Flexor Profundus digitorum* rises from the upper two-thirds of the anterior and internal surfaces of the ulna, and is dovetailed into by the insertion of the brachialis anticus above, reaching back as far as the posterior border of the ulna.

As the middle of the forearm is reached the fleshy mass divides into four tendons, but notice that the outer one, for the index-finger, is much more distinctly separated than are those of the rest of the fingers. This is a valuable lesson on the way in which independent action of a part of a fleshy mass gradually leads to longitudinal segmentation of that mass, because the index is the finger which is used by itself more than any of the others.

The *branches of the ulnar artery in the forearm* are: (1) anterior ulnar recurrent; (2) posterior ulnar recurrent; (3) common interosseous; (4) muscular; (5) anterior ulnar carpal; (6) posterior ulnar carpal.

The *Anterior Ulnar Recurrent Artery* is a small branch running up to the front of the internal condyle, where it anastomoses with the termination of the anterior branch of the anastomotica magna, though a very successful injection is needed to show the anastomosis.

The *Posterior Ulnar Recurrent Artery* is a good deal larger than the last, with which it often rises by a common trunk. Trace it upwards between the flexor sublimis and flexor profundus until it joins the ulnar nerve, which it accompanies between the two heads of the flexor carpi

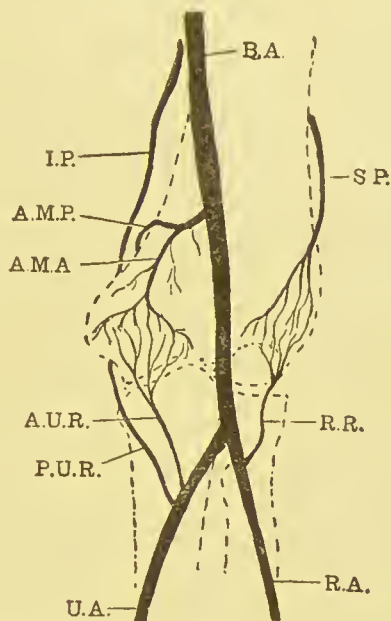


FIG. 313.—DIAGRAM OF THE ARTERIAL ANASTOMOSIS IN FRONT OF THE ELBOW.

B.A. Brachial Artery. *I.P.* Inferior Profunda. *A.M.P.* Posterior Branch of Anastomotica Magna. *A.M.A.* Anterior Branch of Anastomotica Magna. *S.P.* Superior Profunda. *R.R.* Radial Recurrent. *A.U.R.* Anterior Ulnar Recurrent. *P.U.R.* Posterior Ulnar Recurrent. *R.A.* Radial Artery. *U.A.* Ulnar Artery.

ulnaris to the interval between the internal condyle and the olecranon. Here it anastomoses with the inferior profunda and the posterior branch of the anastomotica magna arteries.

The *Common Interosseous Artery* is given off about an inch from the beginning of the ulnar artery. It is a short trunk—only about half an inch long—running backwards

and downwards to reach the upper border of the interosseous membrane, where it divides into its anterior and posterior interosseous branches.

The *Anterior Interosseous Artery and Nerve* may be examined together, since they both pass down in the deep

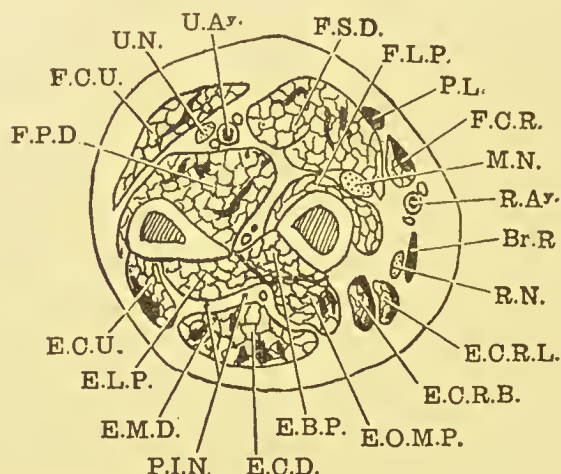


FIG. 314.—SECTION THROUGH THE RIGHT FOREARM AT THE JUNCTION OF THE MIDDLE AND LOWER THIRDS.

(Tendinous parts are black.)

F.S.D. Flexor Sublimis Digitorum. *F.L.P.* Flexor Longus Pollicis. *P.L.* Palmaris Longus. *F.C.R.* Flexor Carpi Radialis. *M.N.* Median Nerve. *R.Ar.* Radial Artery. *Br.R.* Brachio-radialis. *R.N.* Radial Nerve. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.B.* Extensor Carpi Radialis Brevior. *E.O.M.P.* Extensor Ossis Metacarpi Pollicis. *E.B.P.* Extensor Brevis Pollicis. *E.C.D.* Extensor Communis Digitorum. *P.I.N.* Posterior Interosseous Nerve. *E.M.D.* Extensor Minimi Digiti. *E.L.P.* Extensor Longus Pollicis. *E.C.U.* Extensor Carpi Ulnaris. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris. *U.N.* Ulnar Nerve. *U.Ar.* Ulnar Artery.

part of the forearm, in front of the interosseous membrane, which joins the radius to the ulna. Notice that the nerve is superficial (anterior) to the artery, and is also at first a little external to it (see Fig. 314). They both run down between the flexor longus pollicis and flexor profundus digitorum muscles, supplying both of them. Remember that the

flexor profundus digitorum has already received a branch from the ulnar nerve, so that it is a muscle with a double nerve-supply. Minute branches are also given to the radius and ulna, since in both cases the nutrient foramen is on the anterior surface of the bone.

A long delicate branch of the artery usually accompanies the median nerve for some distance down the forearm; it is called the *comes nervi mediani* or *median artery*, and represents a disappearing blood path to the hand.

About the junction of the middle and lower thirds of the forearm the anterior interosseous artery and nerve are lost sight of, as they pass deep to the edge of the pronator quadratus muscle, and it will be better to leave them for a minute until this muscle is examined.

The *Pronator Quadratus* is so hidden by the flexor tendons of the forearm that they should be divided and turned aside. Tie the four tendons of the flexor sublimis digitorum together in two places, and divide them between the ligatures. Do the same for the flexor profundus digitorum tendons, and, finally, divide and reflect the flexor longus pollicis. Do not cut these tendons too near the wrist, because of their synovial sheaths. Now the pronator quadratus is seen rising from the lower quarter of the anterior surface of the ulna, and passing across to be inserted into the same amount of the anterior surface of the radius. Cut right through the muscle from above downwards, being careful not to injure the anterior interosseous nerve; and notice that although the upper edge is quite thin, the muscle thickens rapidly as the wrist is approached, until near its lower edge it is quite half an inch thick. On reflecting the two cut ends it will be seen that the anterior interosseous nerve enters the deep surface of the muscle, and that the main part of the anterior interosseous artery pierces the interosseous membrane to reach the dorsum of the forearm, while a smaller branch continues in front of the membrane to join the anterior carpal arch.

On looking at a radius the thickness of the lower part of the pronator quadratus is explained by noticing that it is inserted into the triangular surface which lies just above the sigmoid cavity for the lower end of the ulna.

The *Anterior Carpal Artery* [ramus carpeus volaris] is a small branch which anastomoses with a corresponding branch of the radial artery to form the *anterior carpal arch*, which usually lies a little above the level of the wrist joint and always deep to all the flexor tendons.

The *Posterior Ulnar Carpal* [ramus carpeus dorsalis] will be seen winding round to the back of the carpus deep to the flexor carpi ulnaris tendon. It will be followed later.

THE PALM OF THE HAND

SURFACE ANATOMY

As in the forearm, the surface markings of the palm are more satisfactorily studied on the student's own hand than on that of the subject. The relations of the soft parts to the surface will be noted as they are exposed.

It is, however, important to notice some points of correspondence between the skin and the skeleton before beginning the actual dissection.

If an articulated carpus is fitted on to the dissector's own hand the pisiform can easily be put in its proper place, since it is so readily felt through the skin; while the tubercle of the scaphoid can be made out, though not so easily, a little below the styloid process of the radius on the outer side.

Now the position of the wrist joint is clear, and will be seen to correspond fairly well to the middle one of the three transverse lines made in the skin by flexing the wrist.

This may be checked by feeling for the styloid processes of the radius and ulna, remembering that the line of the joint forms an arch with its convexity upwards between these. In

localising joints and bony points the hand examined should be constantly moved.

The bases of the metacarpal bones and the carpo-metacarpal articulation are about an inch below the line of the wrist, though they cannot be well felt from the palm. On the ulnar side the hook of the unciform bone should be felt for below and internal to the pisiform. In strong muscular hands it is impossible to make it out, and so it is usually in fat hands, but in slender or emaciated hands it is often easily felt. It is quite in harmony with a work on practical anatomy to advise the reader to examine carefully every hand on which his eyes rest, to learn how greatly hands differ, and how many points are available for a practised observer to note from which he may draw deductions. To gain the power of accurately and rapidly summing up a hand only needs practice, and, when gained, this power is often very useful to a practitioner of medicine.

The metacarpo-phalangeal joints are about half an inch below (nearer the fingers) the lowest of the three well-marked lines on the hand except opposite the index finger, where the line and the joint correspond.

The webs of the fingers and the transverse creases on the palmar aspect of the junction of the fingers with the palm are opposite the middle of the proximal phalanges, but the other transverse creases on the fingers correspond to the interphalangeal joints.

It is of great practical advantage to remember that the length of the terminal joint of a man's index finger is an inch, while the breadth across the fingers of a man's hand is from $2\frac{3}{4}$ to 3 inches.

Skin Incisions.—The hand should be nailed to the table or to a wooden block by long tacks driven through the terminal phalanx of each finger. When the day's dissecting is over these may easily be withdrawn from the wood but left in the fingers.

A vertical incision should be made down the middle of

the palm to the base of the middle finger, after which a transverse incision at right angles to its lower end will allow two flaps of skin to be reflected and turned aside.

The superficial fascia of the palm consists of a quantity of granular fat, the granules being separated by fibrous tissue; where the creases on the surface of the palm occur the skin is bound tightly to the deep palmar fascia.

On the ball of the thumb (*thenar eminence*) and ball of the little finger (*hypothelar eminence*) the fat is not so plentiful or so granular.

In the webs of the fingers some transverse fibres run which are usually spoken of as the *superficial transverse ligament*. Care must be taken not to confuse this with the superficial transverse metacarpal ligament, which will be exposed later. Trace the *palmar cutaneous branches of the median and ulnar nerves* as far as you can in this fascia, and on the ball of the thumb look for twigs of the musculocutaneous, radial and palmar cutaneous of the median. Among the superficial fat of the hypothelar eminence look for the *palmaris brevis muscle*, a thin sheet of fleshy fibres running transversely from the deep palmar fascia to the skin on the inner margin of the palm (see Fig. 310).

Place your own palm in the attitude with which you would use it to scoop up water, and notice how the skin over the hypothelar eminence is thrown into wrinkles—this is due to the action of the palmaris brevis. Clear away the superficial fat and expose the deep palmar fascia, which consists of a central and two lateral parts.

The *lateral parts of the Deep Palmar Fascia* cover the muscles forming the thenar and hypothelar eminences, and in order to see the latter part the palmaris brevis must be reflected.

In doing this take care not to injure the ulnar artery and nerve, which lie very close to its deep surface. It will now be seen that the lateral parts of the deep fascia are quite thin and unimportant.

R.Ay. F.C.R. P.L. F.S.D. U.Ay. U.N.

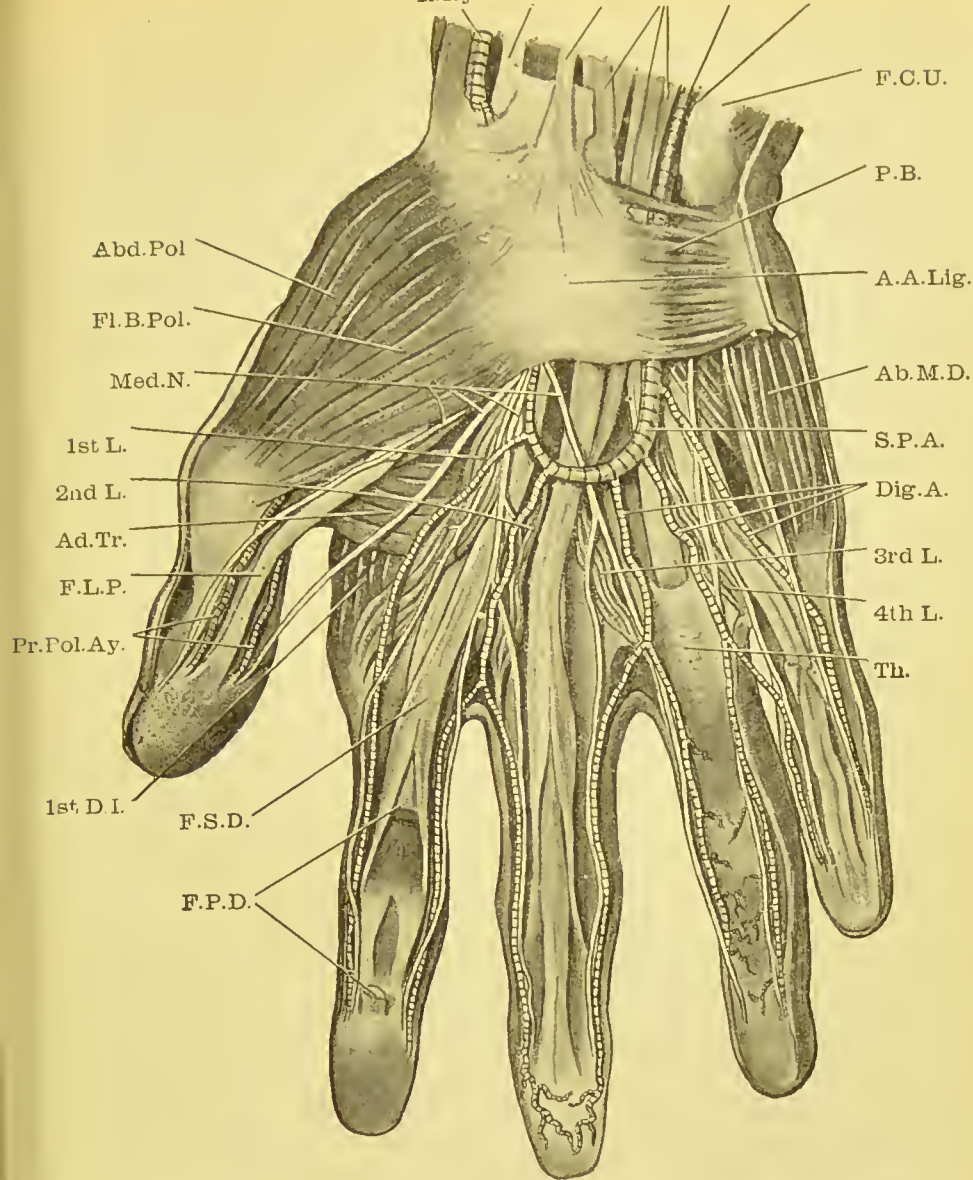


FIG. 315.—SUPERFICIAL DISSECTION OF THE LOWER PART OF THE FOREARM AND OF THE HAND FROM IN FRONT.

R.Ay. Radial Artery. *F.C.R.* Flexor Carpi Radialis. *P.L.* Palmaris Longus. *F.S.D.* Flexor Sublimis Digitorum. *U.Ay.* Ulnar Artery. *U.N.* Ulnar Nerve. *F.C.U.* Flexor Carpi Ulnaris. *P.B.* Palmaris Brevis. *A.A.Lig.* Anterior Annular Ligament. *Abd.M.D.* Abductor Minimi Digiti. *S.P.A.* Superficial Palmar Arch. *Dig.A.* Digital Arteries. 1, 2, 3, 4, *L.* Lumbricales. *Th.* Theca. *F.P.D.* Flexor Profundus Digitorum. *1st D.I.* 1st Dorsal Interosseous. *Pr.Pol.Ay.* Princeps Pollicis Artery. *F.L.P.* Flexor Longus Pollicis. *Ad.Tr.* Adductor Transversus. *Med.N.* Median Nerve. *Fl.B.Pol.* Flexor Brevis Pollicis. *Abd.Pol.* Abductor Pollicis.

The *central part of the Deep Palmar Fascia* is very thick, and will be followed most intelligently if its meaning is understood. It is really the distal end of the palmaris longus tendon, gradually spreading out to reach the proximal phalanges of the four fingers. In the palm it is a triangular plate the apex of which is towards the forearm and is continuous with the palmaris longus tendon when that is present. The base is about the level of the lowest line on the skin of the palm, and here divides into four slips, one for each of the fingers. If these are followed they will be found to divide so that half may be attached to each side of the proximal phalanx.

At the base of the palmar fascia, where it splits into these four digital slips, there are some thick transverse fibres called the *superficial transverse metacarpal ligament*, and just below this, between the slips for the fingers, the digital arteries and nerves will be found dividing for the contiguous sides of the digits (see Fig. 310).

Clear away the delicate deep fascia covering the thenar eminence in order to expose the muscles which form the "ball of the thumb."

The **MUSCLES OF THE THENAR EMINENCE** are three, the abductor pollicis, flexor brevis pollicis, and opponens pollicis. Of these the two former lie on a superficial plane, while the last is deep to both of them (see Fig. 315).

The *Abductor Pollicis* [m. abductor pollicis brevis] is the most external of the two superficial muscles, and rises from the tubercle of the scaphoid and the anterior annular ligament. In most cases a slip from the extensor ossis metacarpi pollicis may be traced into its origin. It is inserted into the outer side of the base of the proximal phalanx of the thumb, and from its insertion a delicate expansion passes back to the extensor longus pollicis tendon on the dorsum.

The *flexor brevis pollicis* lies just internal to the abductor, and rises from the ridge on the trapezium and the anterior annular ligament. Like the former muscle, it is inserted

into the outer side of the base of the proximal phalanx of the thumb.

Divide these two muscles, and turn them aside, when the *opponens pollicis* will be exposed. This has practically the same origin as the flexor brevis, but differs from it in being inserted into the whole length of the metacarpal bone of the thumb. It is usually easily separable into a superficial and a deep lamina.

The nerve to these three muscles will easily be found on reflecting the superficial ones, and may be traced to the median.

The MUSCLES OF THE HYPOTHENAR EMINENCE, when they are normal, are quite symmetrical with those of the thenar eminence, and consist of abductor, flexor brevis, and opponens minimi digiti. Here a word of caution as to the deficiencies of our nomenclature is necessary. Up to the present an abductor has meant a muscle which draws the part on which it acts away from the middle line of the body, while an adductor draws it towards that line. In the hand and foot, however, the mid line of the body is ignored, and the mid line of the extremity is used.

In the hand this line passes through the middle finger, so that the abductor minimi digiti draws the little finger away from the mid line of the hand, but towards that of the body. In order to expose these muscles clear away the deep fascia.

The *Abductor Minimi Digiti* [m. abductor digiti quinti] rises from the pisiform bone, and is inserted into the inner side of the base of the proximal phalanx. As in the thumb, a slight expansion passes back to the extensor tendon on the dorsum of the finger. This muscle is sometimes double.

The *Flexor Brevis Minimi Digiti* [m. flexor digiti quinti brevis] lies lateral to the abductor, and rises from the hook of the unciform and the anterior annular ligament. Like the abductor, it is inserted into the inner side of the base of the proximal phalanx. It is often absent, and when this

absence co-exists with a double abductor, a mistake may easily be made, though, even if it is, it is of little practical importance.

The *deep branch* [ramus profundus] of the *ulnar nerve* should be looked for as it sinks between these two muscles.

The *opponens minimi digiti* [m. opponens digiti quinti] may usually be displayed by drawing the two last muscles apart without dividing them, though this may be done if necessary. It rises from the hook of the unciform and anterior annular ligament, and is inserted into the whole length of the shaft of the metacarpal bone.

The nerve supply of these three short muscles of the little finger will be found coming from the deep branch of the ulnar nerve.

Now trace the *ulnar artery in the hand*. This artery was followed in the forearm as far as the outer side of the pisiform bone, from which it is separated by the ulnar nerve. It reaches the hand by passing superficial to the inner part of the anterior annular ligament, to which it is often bound by some transverse fibres. It now passes deep to the palmaris brevis, and gives off its deep branch, which sometimes accompanies the deep branch of the ulnar nerve, between the abductor and flexor brevis minimi digiti, but more often sinks deeply into the palm on the outer (radial) side of all the short muscles of the little finger.

Now reflect the central part of the deep fascia which conceals and protects the rest of the ulnar artery. When this is done the artery is seen to form the *Superficial Palmar Arch* [arcus volaris superficialis], with its convexity towards the fingers. This arch is sometimes completed by the superficialis volæ branch of the radial artery, sometimes by a branch of the radial to the thumb or index finger, while sometimes it is not completed at all.

It is important to notice the exact position of this arch since it is easily injured. The middle of the three creases on the palm, opposite the middle and ring fingers, is always

just below it; consequently, incisions may safely be made between that line and the fingers. Another guide is to take a horizontal line across the palm from the tip of the outstretched thumb, though this is a little more cumbrous in practice.

Notice most carefully that the superficial palmar arch lies superficial to all the structures in the palm except the central part of the deep palmar fascia, and that the branches of the median nerve lie deep to it, as do also all the tendons to the fingers.

In addition to the deep branch which has been seen, there are four *digital branches* [aa. digitales volares communes] given off from the arch. Of these the innermost passes to the ulnar side of the little finger, while the other three run towards the clefts between the four fingers, and each divides about a quarter of an inch before reaching the cleft into two branches for the neighbouring sides of two fingers. Just before its division an anastomosis with the palmar interosseous branches of the deep palmar arch should be looked for in each of these digital arteries. The anastomosis will usually be found in the cleft between the index and medius fingers, but is often absent in the other two clefts.

A point of great importance is to notice that the arteries near the webs of the fingers lie deeper than the nerves. It is quite a common thing to find them passing through the nerves on their way from the palmar arch to the fingers.

The *Anterior Annular Ligament* [lig. carpi transversum] should now be examined; it is a very strong quadrilateral transverse band attached on the radial side to the tubercle of the scaphoid and to both lips of the groove on the trapezium, while on the ulnar side it is fastened to the pisiform bone and the hook on the unciform. In the living hand it lies deep to that part in which the thenar and hypothenar eminences come nearest to one another.

Superficial to it the following structures have been seen :—

Muscles.—Origin of thenar and hypothenar muscles—palmaris longus, palmaris brevis.

Fibrous Structures.—Palmaris longus tendon, beginning to spread out into deep palmar fascia.

Arteries.—Ulnar.

Veins.—Ulnar venæ comites and superficial veins from the palm to the plexus in front of the wrist.

Nerves.—Ulnar nerve and palmar cutaneous branch of Median.

Now cut the ligament carefully so that the structures deep to it are not injured, and it will be seen at once that it acts as a very important strap to keep the tendons of the flexor sublimis and flexor profundus digitorum, the flexor longus pollicis, and the flexor carpi radialis from starting out of their places whenever the wrist is flexed.

In addition to these tendons the median nerve passes deep to the anterior annular ligament still lying on the outer side of the flexor sublimis digitorum tendons.

The Synovial Sheaths of the Palm.—As they are passing deep to the anterior annular ligament, notice that the tendons are surrounded and packed in by a quantity of lax connective tissue. Between this and the tendons a synovial or bursal sheath is established by their constant movement, and this is of great importance surgically, since it is liable to inflame or even suppurate. Make a single small puncture through it till one of the tendons of the flexor sublimis is reached; then insert a blowpipe with its wire in place, and withdraw the wire, after which the sheath may be inflated with the mouth, or by bellows, or a bicycle pump attached to the blowpipe by a piece of rubber tubing.

When the sheath is blown up it will usually be found to enclose both the flexor sublimis and profundus tendons, and in some few cases the flexor longus pollicis too, though the latter muscle has more often a sheath of its own. The large common sheath of the finger tendons extends above the

suppurative process starting in the tendon sheath in the thumb may easily spread to the palm and cause widespread mischief if not properly treated.

As might be expected, the median nerve, although it is packed in with this loose tissue, has no definite synovial sheath. On tracing the flexor carpi radialis tendon it will be found to pierce the anterior annular ligament, since the

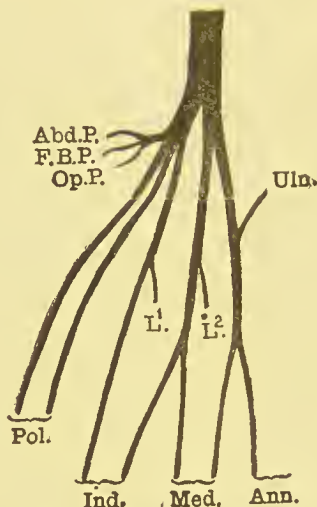


FIG. 317.—DIAGRAM OF THE DISTRIBUTION OF THE MEDIAN NERVE IN THE HAND.

Abd.P. Branch to Abductor Pollicis. *F.B.P.* Branch to Flexor Brevis Pollicis. *Op.P.* Branch to Opponens Pollicis. *Pol.* The two Branches to the Skin of the Thumb. *Ind.*, *Med.*, and *Ann.* stand for the Index, Medius, and Annularis Finger respectively. *L¹*, *L²*. Nerves to the 1st and 2nd Lumbrical Muscles. *Uln.* Communication with Ulnar Nerve.

groove in the trapezium, in which it lies, has the anterior annular ligament attached to both lips. The fibro-osseous tunnel thus formed is lined by a synovial sheath.

The DISTRIBUTION OF THE MEDIAN NERVE IN THE HAND should now be followed. As soon as it leaves the anterior annular ligament the nerve is superficial to the tendons of the flexor sublimis digitorum, and at once becomes rather broader and flatter. It then divides, sometimes into two

very short, stout branches, but more often into six branches at once. Of these the outermost is distributed to the muscles of the ball of the thumb, the second and third supply the two sides of the thumb, the fourth supplies the radial side of the index finger, while the fifth and sixth run to the clefts between the index and medius and medius and annularis, where they divide to supply the neighbouring sides of these digits (see Fig. 317).

The branch to the radial side of the index finger must be carefully dissected, because the nerve to the first lumbrical muscle is given off from it while it is still in the palm. The nerve to the second lumbrical comes from the branch which runs to the cleft between the index and medius fingers.

To see the distribution of the nerves in the fingers median incisions should be made along the palmar surfaces of the index and medius, and the skin reflected in two flaps; if the nerves are now carefully dissected, they will be seen to give off numerous small twigs, at the terminations of which numerous minute white knobs should be looked for. These are the tactile end plates or *Pacinian corpuscles*.

As the tips of the fingers are approached, small twigs are given off to the dorsal surface of the skin over the middle and terminal phalanges, and these twigs are especially abundant in the matrix of the nails.

The Tendons of the Palm and Fingers.—Turn the divided tendons of the flexor sublimis digitorum downwards. As soon as they have passed the metacarpo-phalangeal joint each will be seen to enter a very firm fibrous tunnel known as the *theca* or *digital fibrous sheath* [vagina tendinum digitalis]. It is advisable to dissect two fingers, in order that any points missed in the one may be seen in the other.

The theca is very thick opposite the phalanges and its fibres are transverse, but opposite the joints it is much thinner, to allow flexion of the fingers, and here its fibres cross in an X-like manner. It will readily be seen that any collection of pus in the theca will be closely shut in, and, as it

accumulates, will be subject to a great deal of pressure, thus causing much pain. This occurs in "whitlow," and a deep, bold incision is necessary to relieve the tension.

When the fibrous theca has been studied it should be slit up, and its deep surface will be found lined by shining synovial membrane, which forms the parietal layer of the *digital synovial sheath*. This sheath does not join the synovial sheath of the palm, except in the case of the thumb and occasionally the little finger.

Now lift up the flexor sublimis digitorum tendon gently, and notice that opposite the proximal phalanx it splits, and that each half of it wraps round one side of the tendon of the flexor profundus in such a way that the surface which was dorsal becomes ventral, and *vice versa*.

When the two slips have reached the deep surface of the flexor profundus they join, but soon separate again, to be inserted into the sides of the shaft of the middle phalanx.

The glistening appearance of these tendons shows that they are closely invested with synovial membrane, and at certain places this is reflected on to the parietal layer lining the theca from the deep surface of the tendon. In this way two sets of delicate synovial bands are formed, known as the *vincula vasculosa*, since they carry minute vessels to the tendons in the same way that the mesentery does to the intestines. One of these is called the vinculum breve, and is close to the insertion of the flexor sublimis, while the other is farther away from the insertion, and is often double; the two are then known as the *vincula longa*.

Reflect the flexor sublimis digitorum, and follow two of the tendons of the flexor profundus to their insertions. These tendons lie deep to the former, and pass through the splitting which has been noticed in order to reach the palmar aspect of the bases of the terminal phalanges. They also have vincula reflected from their deep surface, but the vinculum longum is single, and often runs only from the profundus to the sublimis tendon.

Rising from the tendons of the flexor profundus digitorum in the palm are the four *lumbrical muscles*. Of these the outer two rise from one tendon each, while the other two rise from contiguous sides of two tendons.

Each lumbrical passes round the outer side of its own finger, lying in front of the deep transverse metacarpal ligament, which will be noticed later, to reach the dorsum, where it will be seen to join the expansion on the common extensor tendon.

Dissect the outermost of these very carefully, and notice that it passes in front of the transverse axis, round which the metacarpo-phalangeal joint works; consequently it is a flexor of this joint, and then, by pulling on the extensor tendon, extends the two interphalangeal joints. The same facts apply to the other lumbricals, only they are not so easily exposed without separating the metacarpal bones.

The nerves to the two outer lumbricals have been seen entering them on their superficial surface, but in the case of the two inner ones it is necessary to lift the muscles and to dissect their deep surface very carefully. When this is done a small twig from the deep branch of the ulnar nerve will be found entering each of them.

DEEP STRUCTURES IN THE PALM

Turn the long flexor tendons over the fingers and examine the adductors of the thumb, of which there are two.

The *adductor pollicis transversus* rises from the palmar aspect of the shaft of the metacarpal bone of the middle finger, and its fibres converge to a tendon which is inserted into the inner side of the proximal phalanx of the thumb. It is separated from the next muscle by the deep palmar arch.

The *adductor pollicis obliquus* rises from the palmar surfaces of the os magnum, trapezoid, and the bases of the metacarpal bones of the index and medius fingers. It runs

obliquely downwards and outwards to the base of the proximal phalanx of the thumb. Its main insertion is into the inner side of the palmar surface of the base of this phalanx, but a slip of varying size always separates from it

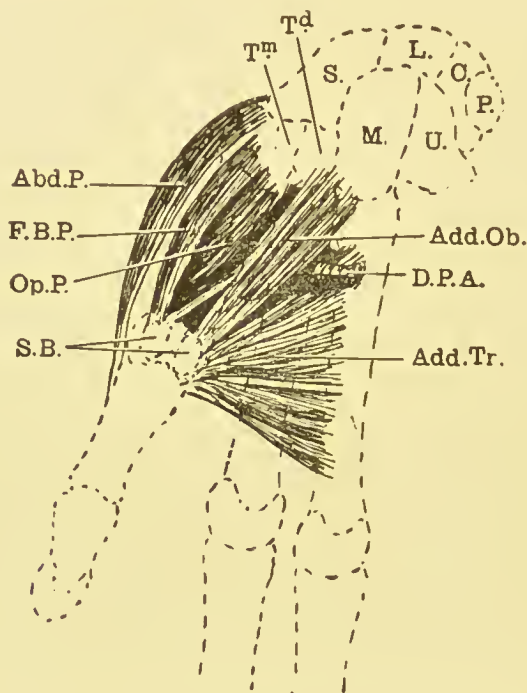


FIG. 318.—THE VARIOUS SHORT MUSCLES OF THE THUMB.

S. Scaphoid. *L.* Semilunar. *C.* Cuneiform. *P.* Pisiform. *U.* Unciform. *M.* Os Magnum. *T^d*. Trapezoid. *T^m*. Trapezium. *Abd.Pol.* Abductor Pollicis. *F.B.P.* Flexor Brevis Pollicis. *Op.P.* Opponens Pollicis. *S.B.* Sesamoid Bones. *Add.Ob.* Adductor Obliquus. *Add.Tr.* Adductor Transversus. *D.P.A.* Deep Palmar Arch.

and runs deep to the tendon of the flexor longus pollicis to reach the outer side of the base of the proximal phalanx.

In each of these insertions a sesamoid bone is developed which will be better seen when the joints are being examined. From the inner insertion a fibrous expansion runs round the inner side of the thumb to the extensor longus pollicis tendon on the dorsum.

The two adductors of the thumb are supplied by the deep branch of the ulnar nerve, and are therefore clearly a separate group from the muscles of the ball of the thumb which are supplied by the median. In spite of this, however, the flexor brevis, opponens and adductor obliquus are often closely united, and a good deal of attention to their insertions is necessary in order to separate them, though even then the assistance of the demonstrator's experience may be needed. In the foregoing description nothing has been said about a deep head of the flexor brevis pollicis, since the name has been used by different writers for three distinct muscular slips. On account of the confusion connected with it, the student is strongly advised not to use the name at all.

The *Deep Palmar Arch* [arcus volaris profundus] is now partly exposed, but in order to see the whole of it the adductor pollicis obliquus muscle should be cut across and reflected. The radial artery will then be seen entering the palm between the metacarpal bones of the thumb and index finger, and in doing so it pierces the origin of the first dorsal interosseous muscle. At first it lies deep to the adductor obliquus and superficial to the base of the metacarpal bone of the index finger, but as soon as it reaches the base of the medius metacarpal it passes between the adjacent edges of the oblique and transverse adductors, and then crosses the palm just superficial to the bases of the other metacarpal bones to anastomose with the deep branch of the ulnar artery, which has been seen already. It is this part of its course which is called the deep palmar arch.

Its position in the living palm may be found by drawing a transverse line half an inch nearer the wrist than that of the superficial arch.

Before it comes out between the two adductors of the thumb, and while it is still lying deep to the adductor obliquus, it gives off the following branches:—

Arteria Princeps Pollicis, which divides and forms a loop on the "pad" of the thumb.

Arteria Radialis Indicis, running along the radial border of the index, and often completing the superficial palmar arch by a lateral anastomosis.

First Palmar Interosseous, which runs not in the first but in the second intermetacarpal space, and joins the digital artery from the superficial palmar arch, as has already been seen.

After the deep arch has passed between the two adductors of the thumb, it gives off its *second and third palmar*

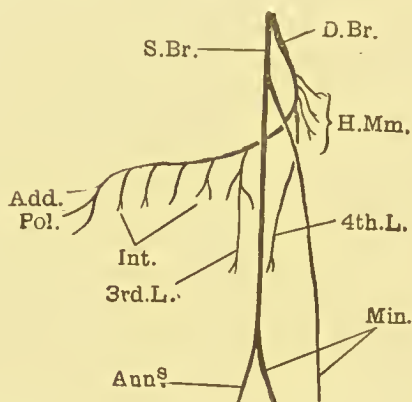


FIG. 319.—DIAGRAM OF THE DISTRIBUTION OF THE ULNAR NERVE IN THE HAND.

S.Br. Superficial Branch. *D.Br.* Deep Branch. *Ann^s.* Branch to Ring Finger. *Min.* Branches to Little Finger. *H.Mm.* Twigs to Hypothenar Muscles. *3rd* and *4th L.* Branches to 3rd and 4th Lumbrical Muscles. *Int.* Branches to Palmar and Dorsal Interosseous Muscles. *Abd.* Branches to Adductors Obliquus and Transversus.

interosseous arteries, which are usually much smaller than the first, and also *perforating branches*, which pass back between the metacarpal bones to the dorsum of the hand.

Accompanying the deep palmar arch is the *Deep Branch of the Ulnar Nerve*, which has already been seen dipping down between the abductor and flexor brevis minimi digiti when both these muscles are present; it then runs through the origin of the opponens minimi digiti, often grooving the hook of the unciform. Its relation to the deep palmar arch

is variable, but it very frequently crosses the arch obliquely so as to end nearer the fingers.

It is the great motor nerve of the hand, and supplies all the muscles of the hypothenar eminence, the two inner lumbricals, all the interossei and the two adductors of the thumb. Perhaps a simpler way of stating the case is to remind the disscetor that he has already seen the median nerve supplying the muscles of the thenar eminence and the two outer lumbricals, that he has traced a twig from the superficial branch of the ulnar into the palmaris brevis, and that every other muscle confined to the hand is supplied by the deep branch of the ulnar nerve.

The *Palmar Interosseous Muscles* [imm. interossei volares] must next be examined. There are three of these, and their action is to draw the fingers towards the medius. Each rises from the shaft of one metacarpal bone, and is inserted into the base of the proximal phalanx and dorsal expansion of the extensor tendon of the same digit; furthermore, they always lie on that side of their respective fingers which is toward the middle finger. As there is no distinct palmar interosseous muscle in the first space, it follows that the first of them must be looked for on the ulnar side of the index metacarpal, the second on the radial side of the annularis metacarpal, and the third on the radial side of the minimus.

When these muscles have been separated from their origins and turned downwards, the *dorsal interossei* are exposed from the palm.

These muscles are four in number, and therefore one is found in each space. They differ from the palmar interossei in rising from two adjacent metacarpal bones instead of one, and they draw the fingers away from a line passing down the centre of the middle finger. To do this the first is inserted into the base of the proximal phalanx and dorsal expansion of the radial side of the index, the second into the radial side of the medius, the third into the ulnar side of the medius, and the fourth into the ulnar side of the annularis.

In dissecting these palmar and dorsal interossei right up to their insertions, notice that they pass dorsal to the *deep transverse metacarpal ligament* which joins the palmar ligaments of the metacarpophalangeal joints of the four fingers together. By this ligament, therefore, they are separated from the lumbricals. Another and much more feeble ligament joins the heads of the metacarpal bones of the fingers together behind. This is the *dorsal transverse metacarpal ligament*, which, with the deep transverse liga-

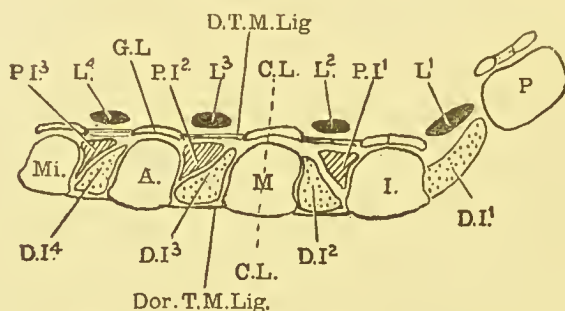


FIG. 320.—A DIAGRAMMATIC TRANSVERSE SECTION THROUGH THE HEADS OF THE METACARPAL BONES TO SHOW THE RELATIVE POSITIONS OF THE INTEROSSEI AND LUMBRICALES.

P. Pollex. *I.* Index. *M.* Medius. *A.* Annularis. *Mi.* Minimus. *L.* 1, 2, 3, and 4. The corresponding Lumbricales. *P.I.* 1, 2, and 3. The Palmar Interossei. *D.I.* 1, 2, 3, 4. The Dorsal Interossei. *C.L.* The Central Line towards which the Palmar Interossei, and away from which the Dorsal Interossei, act. *D.T.M.Lig.* Deep Transverse Metacarpal Ligament. *Dor.T.M.Lig.* Dorsal Transverse Metacarpal Ligament. *G.L.* Glenoid ligament.

ment just mentioned, forms three osseo-fibrous tunnels between the four fingers in which the palmar and dorsal interosseous muscles lie.

As these different transverse ligaments of the hand are confusing, the dissector may be glad to have them recapitulated.

1. The *Superficial Transverse Ligament* in the webs of the fingers.

2. The *Superficial Transverse Metacarpal Ligament*—a part of the palmar fascia.

3. The *Deep Transverse Metacarpal Ligament*, fastening the heads of the metacarpal bones together on their palmar aspects.

4. The *Dorsal Transverse Metacarpal Ligament*, fastening the heads of the metacarpal bones together on their dorsal aspects.

Opposite the bases of the metacarpal bones arteries pass between the two heads of the dorsal interosseous muscles. In the first space the radial artery does so, and in the other three spaces the perforating branches of the deep palmar arch.

Now replace the adductor transversus pollicis for one minute, and notice that below it, *i.e.* nearer the finger-tips, the first dorsal interosseous muscle appears. This appearance, if it has not been specially noticed, is often a point of difficulty in the examination-room.

THE BACK OF THE FOREARM AND HAND

SURFACE ANATOMY.—The relations of the soft parts to the surface will be noticed as they are exposed, and may then be identified on the dissector's own forearm and hand, but the following bony landmarks should be made out at once.

The subcutaneous posterior surface of the olecranon has already been noticed; from it the finger may be run down the whole length of the posterior border of the ulna until the styloid process at the lower extremity of the bone is reached. When the forearm is pronated the lower end of the ulna is very evident dorsally as a rounded knob.

On supinating the forearm the line of the posterior border of the ulna will be found marked by a deep groove between the flexor and extensor muscles, and from the surgeon's point of view it is a very important thing to remember that the whole length of the ulna can be explored through the skin.

The head of the radius has been felt below and behind

the external condyle of the humerus already, and below that it is covered by muscles until the lower end is reached.

Here some of the ridges separating the grooves on its posterior and outer surfaces may be felt, as may also its styloid process on the outer side of the wrist.

The back of the wrist joint is easily localised, especially if it be alternately flexed and extended.

The head of the os magnum often forms a rounded knob in the line of the middle finger when the wrist is fully flexed. This gives an indication of the transverse carpal joint, and the joint itself can be made out by pressing firmly with the index finger, and flexing, extending, abducting and adducting the carpus.

In feeling for all these joints the great point is to slip the finger into the intervals between the extensor tendons.

The carpo-metacarpal joints are more difficult to feel, though it may be done in most hands if the fingers are moved about freely enough.

The metacarpo-phalangeal joints are easily felt on each side of the extensor tendons. Notice that the first series of knuckles are the rounded heads of the metacarpal bones and not the bases of the phalanges. Notice, too, how greatly the length of the fingers differs in different individuals.

The shape and appearance of the finger-tips and nails is always worth noticing, though perhaps all that may be learnt from them hardly comes within the range of a dissecting manual.

SKIN INCISIONS.—As the skin on the front of the forearm has already been reflected in two flaps, it is of little practical use to try to make two for the back, since there is nothing to hold them in place.

The most convenient thing is to turn down the whole of the skin of the forearm and hand as far as the knuckles, and to retain it for covering the dissection when put away.

SUPERFICIAL STRUCTURES

It will be noticed on clearing away the superficial fasciæ that, although there is a plexus of large veins on the dorsum of the hand, there are few on the dorsal surface of the forearm. This is due to the fact that the larger veins curve round the radial and ulnar borders of the forearm to reach the anterior surface.

There are three cutaneous nerves on the back of the forearm:—

1. *The posterior branch of the musculo-cutaneous.* Look for this running back round the radial border of the forearm, an inch or two below the external condyle; it is not a very large branch, but can usually be dissected as far as the wrist, where it communicates with and overlaps the radial nerve.

2. *The lower external cutaneous branch of the musculo-spiral nerve.* This will be found nearer the mid line of the forearm, and may often be traced well on to the dorsum of the hand.

3. *The posterior branch of the internal cutaneous nerve.*—This should be looked for curving round the ulnar side of the forearm, only a little distance below the internal condyle. These three nerves communicate with one another by their terminal twigs. On the dorsum of the hand the skin is supplied by the radial and by the dorsal cutaneous branch of the ulnar nerve.

The *radial nerve* has been traced as far as the lower third of the front of the forearm, where it disappeared deep to the tendon of the brachio-radialis muscle. If the posterior border of the tendon is carefully dissected, the nerve will be easily picked up, and will be seen to divide into branches for the dorsum of the thumb as well as the index and outer side of the medius fingers. It very often supplies in addition the sides of the left between the medius and annularis. It has already been noticed how the branches of the median supply

the skin of the dorsum of the distal phalanges of the outer $3\frac{1}{2}$ digits; indeed, the overlap of these cutaneous nerves in the hand is so great that in some cases in which the radial nerve is divided no loss of sensation is appreciable.

The *dorsal cutaneous branch of the ulnar nerve* was seen passing back from the main nerve deep to the tendon of the flexor carpi ulnaris. It should be picked up where it is emerging from the posterior border of the tendon and traced to the dorsal surface of the little and ring fingers. One of its branches almost always communicates with the radial nerve, and it often directly supplies the ulnar (inner) $2\frac{1}{2}$ instead of $1\frac{1}{2}$ digits. As in the outer fingers, the dorsal branch of the ulnar nerve does not supply the skin over the terminal phalanx. This is done by the palmar branch.

The experience gained in dissecting these nerves will probably have impressed this generalisation upon the dissector—that the cutaneous nerves are deep to the superficial veins until the former become very fine branches.

DEEPER DISSECTION OF THE BACK OF THE FOREARM

Remove the deep fascia as high as can be managed without injuring the subjacent muscles; where these are obviously rising from the fascia, it must be left. Be careful of the *posterior annular ligament* [lig. carpi dorsale], which is on a higher level than the anterior, and is attached to the lower end of the radius externally, bridging over the four grooves on that bone; internally it goes lower and reaches the euneiform bone as well as the lower end of the ulna. It is a thickening of the deep fascia, and acts as a strap to prevent the extensor tendons starting up during extension of the wrist. The muscles of the back of the forearm are arranged in two layers, of which the more superficial arise from the external condyle or supracondylar ridge of the humerus as well as from the fascia covering them, and the intermuscular septa separating them from adjacent muscles.

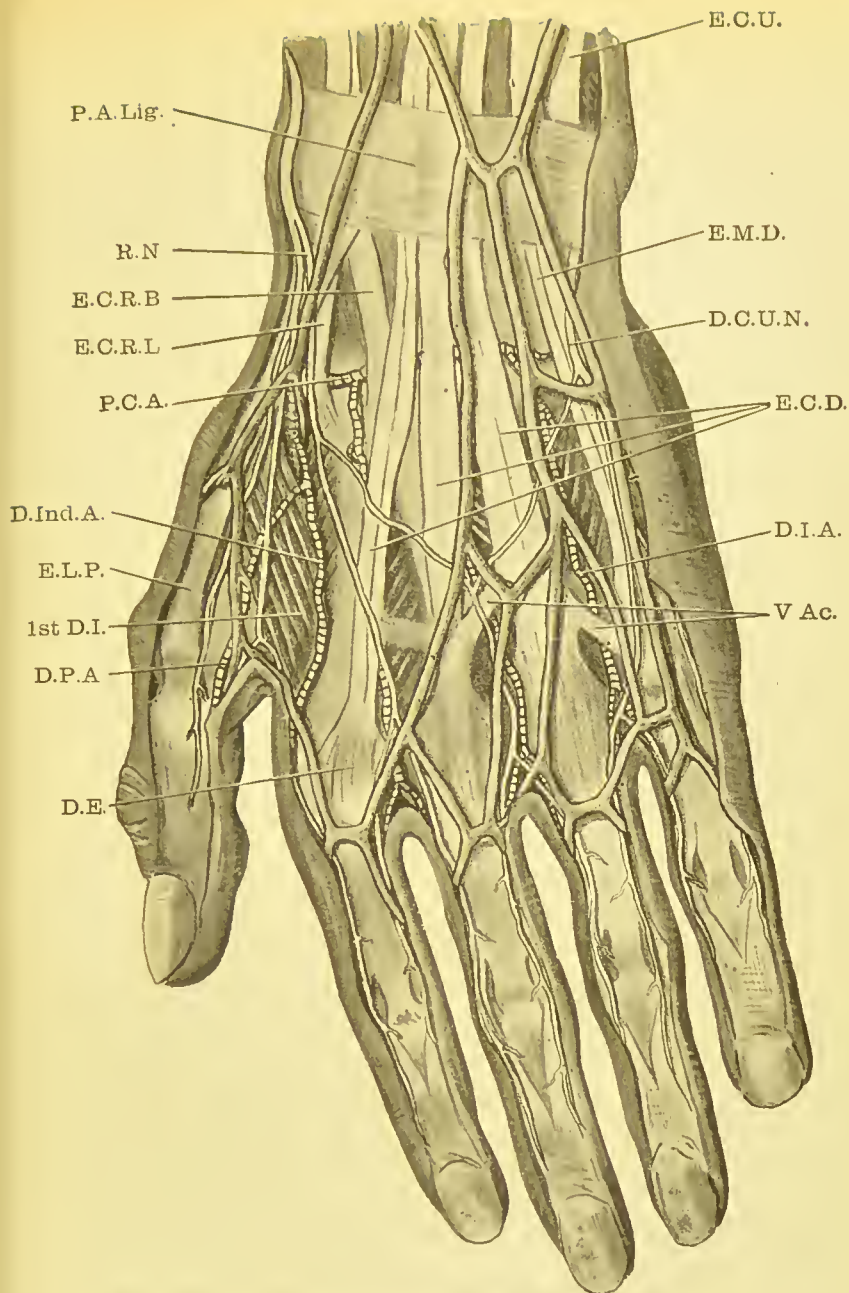


FIG. 321.—DISSECTION OF THE DORSUM OF THE HAND.

E.C.U. Extensor Carpi Ulnaris. *E.M.D.* Extensor Minimi Digiti. *D.C.U.N.* Dorsal Cutaneous Branch of the Ulnar Nerve. *E.C.D.* Extensor Communis Digitorum. *D.I.A.* Dorsal Interosseus Artery. *V.Ac.* Vincula Accessoria. *D.E.* Dorsal Expansion of Extensor Tendon. *D.P.A.* Dorsalis Pollicis Artery. *1st D.I.* First Dorsal Interosseous Muscle. *E.L.P.* Extensor Longus Pollicis. *D.Ind.A.* Dorsalis Indicis Artery. *P.C.A.* Posterior Carpal Arch. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.B.* Extensor Carpi Radialis Brevior. *R.N.* Radial Nerve. *P.A.Lig.* Posterior Annular Ligament.

The outermost of the superficial layers of muscles is the *extensor carpi radialis longior* [E.C.R. longus], which comes from the lower third of the external supracondylar ridge, and is remarkable for the shortness of its fleshy belly; as it passes downwards its tendon will be seen to pass deep to two muscles of the deeper layer, the *extensor ossis metacarpi*

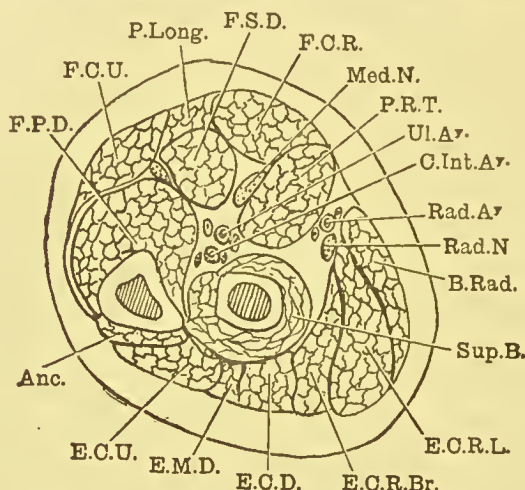


FIG. 322.—SECTION OF THE RIGHT FOREARM AT THE JUNCTION OF THE UPPER AND MIDDLE THIRDS.

F.C.R. Flexor Carpi Radialis. *Med.N.* Median Nerve. *P.R.T.* Pronator Radii Teres. *Ul.Ar.* Ulnar Artery. *C.Int.Ar.* Common Interosseous Artery. *Rad.Ar.* Radial Artery. *Rad.N.* Radial Nerve. *B.Rad.* Brachio-radialis. *Sup.B.* Supinator Brevis. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.Br.* Extensor Carpi Radialis Brevior. *E.C.D.* Extensor Communis Digitorum. *E.M.D.* Extensor Minimi Digiti. *E.C.U.* Extensor Carpi Ulnaris. *Anc.* Anconeus. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris (deep to this is the Ulnar Nerve). *P.Long.* Palmaris Longus. *F.S.D.* Flexor Sublimis Digitorum.

pollicis and the *extensor brevis pollicis*. After that the tendon passes through the second of the four grooves on the lower end of the radius, which is the outermost groove on the back of that bone, because the first groove is on the outer side and not really upon the back. Passing over the carpal bones, the tendon is inserted into the outer side of the meta-

carpal bone of the index finger, and at its insertion lies deep to the tendon of the extensor longus pollicis (see Fig. 321). Divide the muscle where its tendon begins, and look for its nerve from the musculo-spiral.

The *extensor carpi radialis brevis* [E.C.R. brevis] comes from the external condyle by the common extensor origin already mentioned. It lies deep to the last muscle, and so close to it that some care is necessary in separating them. Its fleshy belly is a good deal longer than the last, and its tendon has the same relations, passes through the same groove, and is inserted into the base of the metacarpal bone of the middle finger at the root of its styloid process. Divide the muscle, and look for its nerve coming from the posterior interosseous before that nerve pierces the supinator brevis.

The *extensor digitorum communis* lies on the ulnar side of the extensor carpi radialis brevis. Follow it down from the common tendon, and notice that in the lower third of the forearm it divides into four tendons, which pass through the innermost groove on the back of the radius. After this each passes to its own finger, but while they are on the dorsum of the hand they are connected by bands known as *vincula accessoria* [junctura tendinum] (see Fig. 321). The vinculum between the tendons for the index and medius is usually feeble, if it is present at all, and this, no doubt, is associated with the free mobility of the index. The other two vincula pass obliquely downwards from the annularis tendon to those of the medius and minimus, and enable the tendon to the ring finger to help the one on each side of it. These vincula accessoria, or "helping bands," should not be confused with the vincula vasculosa in the flexor sheaths.

Follow one tendon along the dorsum of a finger, preferably the medius, and notice that opposite the proximal phalanx it forms the *dorsal expansion*, which resembles the barbed head of an arrow. Each barb is wrapped round the side of the phalanx, and receives the insertion of the lumbricales and interossei. The radial barb of each expansion receives a

lumbricalis, while the interossei vary with the particular

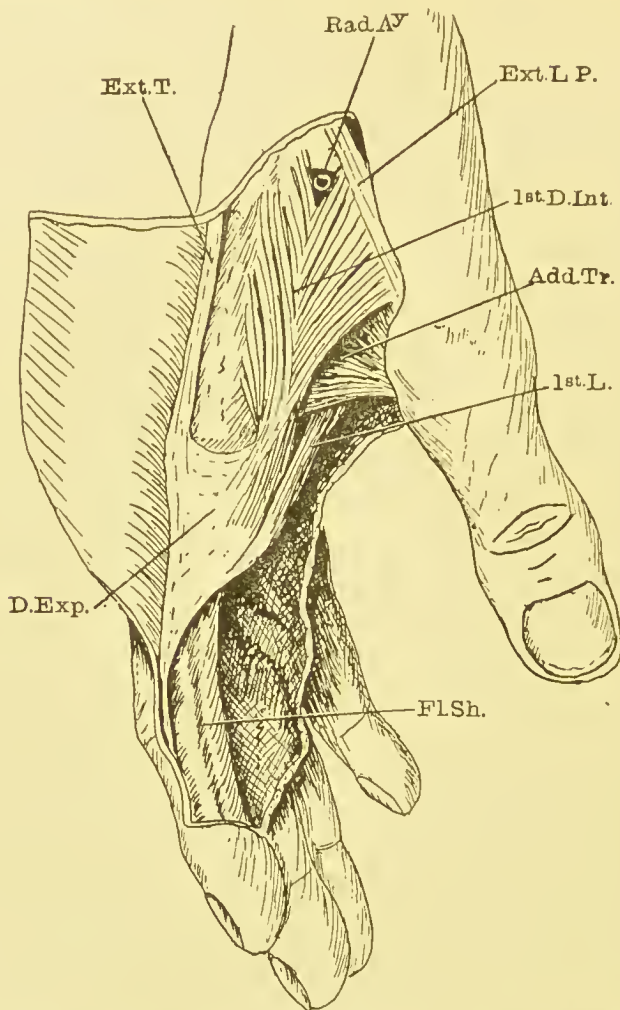


FIG. 323.—THE DORSAL EXPANSION OF THE EXTENSOR TENDON OF THE INDEX.

Ext.T. Extensor Tendon. *Rad.Ar.* Radial Artery. *Ext.L.P.* Extensor Longus Pollicis. *1st D.Int.* First Dorsal Interosseus Muscle. *Add.Tr.* Adductor Transversus. *1st L.* First Lumbrical. *Fl.Sh.* Flexor Sheath. *D.Exp.* Dorsal Expansion of Extensor Tendon.

finger. In the case of the middle finger a dorsal interosseous muscle is inserted into each barb, but in the other fingers the

interossei may easily be thought out when once their arrangement, given on p. 333, is understood.

The tendon is continued on from the apex of the arrow-head, and, as the middle phalanx is approached, splits into three bands. Of these the middle one is inserted into the dorsum of the base of the middle phalanx, and the two lateral ones join each other to be inserted into the base of the terminal phalanx (see Fig. 321).

The *extensor minimi digiti* [m. extensor digiti quinti proprius] lies on the ulnar side of the extensor communis digitorum, and has the same origin. For all practical purposes it is a part of that muscle, save that it passes through a separate compartment of the posterior annular ligament, and lies in a groove between the lower ends of the radius and ulna. Here it makes a slight bend inward, and, on the dorsum of the hand, always divides into two tendons (see Fig. 324), which, however, unite once more as the little finger is approached, and join the minimus tendon of the extensor communis just before the dorsal expansion is formed. In many cases there is no tendon from the extensor communis to the little finger, and then the vinculum accessorium from the ring finger tendon joins the extensor minimi digiti just before the dorsal expansion begins.

The *extensor carpi ulnaris* is the innermost of the superficial muscles on the back of the forearm. It has the same origin as the other muscles from the external condyle, intermuscular septum, and deep fascia, but in addition it rises from the posterior subcutaneous border of the ulna in its middle third. This is easily demonstrable if an attempt is made to lift the muscle up from its bed. It plays over the inner half of the posterior surface of the ulna, but is not attached to it. At the wrist its tendon traverses the innermost compartment of the posterior annular ligament, and lies in a groove on the back of the lower end of the ulna. Trace its insertion into the dorsum of the base of the metacarpal bone of the little finger.

Now divide the fleshy bellies of the extensor communis digitorum, extensor minimi digiti, and extensor carpi ulnaris, and turn their ends up and down. In doing this look very carefully for the branches of the posterior interosseous nerve

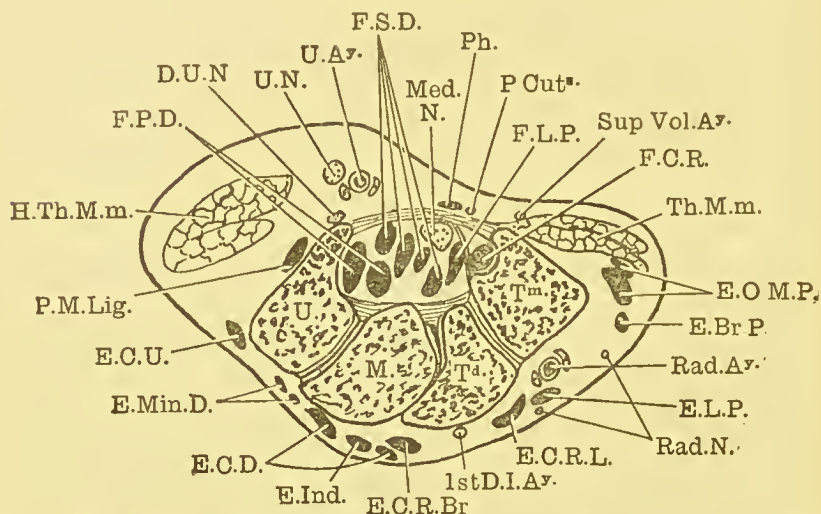


FIG. 324.—SECTION THROUGH THE CARPUS TO SHOW THE RELATIONS OF THE EXTENSOR TENDONS.

T^m, Trapezium. *T^d*, Trapezoid. *M. Os Magnum*. *U*, Unciform (from the Hook of this the Anterior Annular Ligament stretches across to the Trapezium). *Ph*, Palmaris Longus. *P.Out.*, Palmar Cutaneous Branch of Median Nerve. *F.L.P.*, Flexor Longus Pollicis. *S.Vol.A.*, Superficialis Volæ Artery. *F.C.R.*, Flexor Carpi Radialis. *Th.M.m.*, Thenar Muscles. *E.O.M.P.*, Extensor Ossis Metacarpi Pollicis. *E.Br.P.*, Extensor Brevis Pollicis. *E.L.P.*, Extensor Longus Pollicis. *Rad.A.*, Radial Artery. *Rad.N.*, Radial Nerve. *E.C.R.L.*, Extensor Carpi Radialis Longior. *E.C.R.Br.*, Extensor Carpi Radialis Brevior. *1st D.I.A.*, First Dorsal Interosseous Artery. *E.Ind.*, Extensor Indicis. *E.C.D.*, Extensor Communis Digitorum. *E.Min.D.*, Extensor Minimi Digiti. *E.C.U.*, Extensor Carpi Ulnaris. *P.M.Lig.*, Pisis-metacarpal Ligament. *H.Th.M.m.*, Hypothenar Muscles. *F.P.D.*, Flexor Profundus Digitorum. *D.U.N.*, Deep Branch of Ulnar Nerve. *U.N.*, Ulnar Nerve. *U.A.*, Ulnar Artery. *F.S.D.*, Flexor Sublimis Digitorum. *Med.N.*, Median Nerve.

by which they are all supplied; these enter the muscles on their deep surfaces.

The *supinator brevis* [m. supinator], already seen from the front, may now be fully examined. Its origin is from the

external lateral ligament of the elbow joint, and through that from the external condyle, from the intermuscular septa between it and the more superficial muscles now reflected, from the orbicular ligament surrounding the head of the radius, and from the posterior part of the triangular fossa below the lesser sigmoid cavity of the ulna. From this origin its fibres are wrapped round the outer side of the upper part of the radius from behind forward, so that the more the radius is pronated the tighter they are twisted round it. Their action, therefore, is to untwist themselves and by so doing to supinate the radius (see Fig. 322).

Find the posterior interosseous nerve as it is entering the muscle, and put it on the stretch. It obviously passes between a superficial and a deep layer. Divide the former along the course of the nerve, and notice that it is inserted along the oblique line of the radius in front and just above the insertion of the pronator radii teres externally.

When the superficial layer of the supinator brevis is reflected, the deeper layer will be found inserted into the front of the neck of the radius all round except at its postero-internal part; it also extends on to the shaft for about $1\frac{1}{2}$ inch. The greater part of the *posterior interosseous nerve* is now exposed, and may be followed from its beginning, in front of the external condyle, round the outer side of the radius, between the two layers of the supinator brevis, to the lower border of that muscle. Here it is near the mid line of the back of the forearm, and divides into a brush of branches. It will be remembered or noticed once more that twigs are given off for the extensor carpi radialis brevior and supinator brevis before the nerve passes through the latter muscle. After it comes out branches are given to all the other muscles of the back of the forearm, except the anconeus, brachio-radialis, and extensor carpi radialis longior, which are supplied directly from the musculo-spiral. The various twigs lie between the superficial and deep layers of muscles,

and therefore enter the former on their deep surfaces, the latter on their superficial.

One slender branch passes to the back of the interosseous membrane, but will be followed more easily when the deep layer of muscles has been studied.

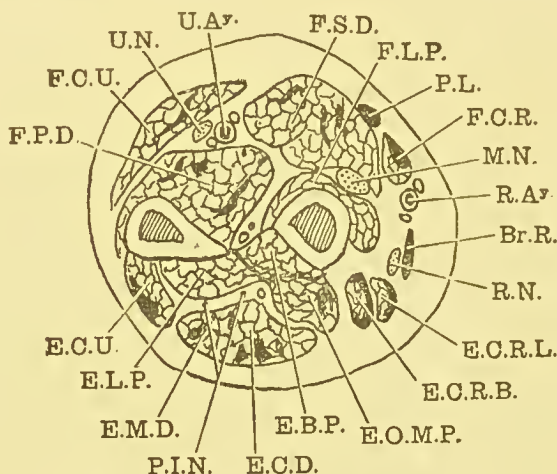


FIG. 325.—SECTION THROUGH THE RIGHT FOREARM AT THE JUNCTION OF THE MIDDLE AND LOWER THIRDS.

(Tendinous parts are black.)

F.S.D. Flexor Sublimis Digitorum. *F.L.P.* Flexor Longus Pollicis. *P.L.* Palmaris Longus. *F.C.R.* Flexor Carpi Radialis. *M.N.* Median Nerve. *R.Ar.* Radial Artery. *Br.R.* Brachio-radialis. *R.N.* Radial Nerve. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.B.* Extensor Carpi Radialis Brevior. *E.O.M.P.* Extensor Ossis Metacarpi Pollicis. *E.B.P.* Extensor Brevis Pollicis. *E.C.D.* Extensor Communis Digitorum. *P.I.N.* Posterior Interosseous Nerve. *E.M.D.* Extensor Minimi Digiti. *E.L.P.* Extensor Longus Pollicis. *E.C.U.* Extensor Carpi Ulnaris. *F.P.D.* Flexor Profundus Digitorum. *F.C.U.* Flexor Carpi Ulnaris. *U.N.* Ulnar Nerve. *U.Ar.* Ulnar Artery.

The deep extensor muscles of the forearm are, from above downwards : (1) the extensor ossis metacarpi pollicis ; (2) the extensor brevis pollicis ; (3) the extensor longus pollicis ; and (4) the extensor indicis.

The *extensor ossis metacarpi pollicis* [m. abductor pollicis longus] rises from the posterior surfaces of both bones of the

forearm as well as from the interosseous membrane. It is the next muscle below the supinator brevis, and winds round the outer side of the radius on its way down to the groove just above the styloid process of that bone. If a living forearm be looked at and the thumb abducted, the belly of this muscle will at once swell up; even when at rest it forms a slight bulging deep to the skin on the outer side of the lower third of the back of the forearm. Trace the tendon to the outer side of the base of the metacarpal bone of the thumb, and look out for a slip to the abductor pollicis or to the trapezium, both of which are quite common.

The *extensor pollicis brevis* rises from the posterior surface of the radius just below the last, and passes with it through the same groove on the outer side of the lower end of the radius. It is, however, continued on as a delicate tendon to the dorsum of the base of the proximal phalanx of the thumb. In a small number of cases this muscle is absent.

The *extensor pollicis longus* rises from the posterior surface of the ulna just below the origin of the extensor ossis metacarpi pollicis, and, running downwards, its tendon passes through the third compartment of the posterior annular ligament in the narrow, deep groove on the posterior surface of the lower end of the radius. Notice that here it turns rather sharply outwards, using the outer lip of the groove as a pulley, on its way to the dorsum of the base of the terminal phalanx of the thumb. As it is passing the proximal phalanx it receives some fibres from the abductor pollicis on its outer side and from the adductor obliquus on its inner.

The space between the tendons of the extensor ossis metacarpi and extensor longus pollicis is often spoken of as the "anatomical snuff-box." It is very easily seen in the living hand, and the surface markings of the tendons bounding it should be carefully noted. With a little practice the tendon of the extensor brevis pollicis may be made to stand out on the ulnar side of that of the extensor ossis metacarpi.

In this space are found the beginning of the radial vein most superficially, then some twigs of the radial nerve, while most deeply is the second part of the radial artery, which is sometimes tied here.

The *extensor indicis* [M.E.I. proprius] is the lowest muscle rising from the posterior surface of the ulna. In order to see it fully, cut the posterior annular ligament where it is binding down the extensor communis digitorum, and turn these tendons farther down over the fingers. It will now be seen that the extensor indicis passes through the same compartment of the ligament as the extensor communis digitorum, and that it joins the index slip of the latter muscle on its ulnar side before the dorsal expansion begins.

Now follow the course of the *posterior interosseous artery* at the back of the forearm. After passing between the two bones, it appears in the interval between the lower edge of the supinator brevis and the upper edge of the extensor ossis metacarpi pollicis.

It then runs down the forearm between the superficial and deep layers of muscles, and close to the twigs of the posterior interosseous nerve.

When it first appears it gives off the *posterior interosseous recurrent branch*, which runs upwards superficial to the supinator brevis, and deep to the anconeus, to join the anastomosis round the olecranon already noticed. It is necessary to cut and reflect the anconeus in order to follow this branch.

In its course the posterior interosseous artery supplies the muscles of the back of the forearm, and, since it has no help, it is used up by the time the lower third is reached. The deficiency in the lower third of the forearm is made good by the *posterior branch of the anterior interosseous artery*, which was seen perforating the interosseous membrane when the front of the forearm was dissected (see p. 314). In order to trace it at the back, cut and reflect

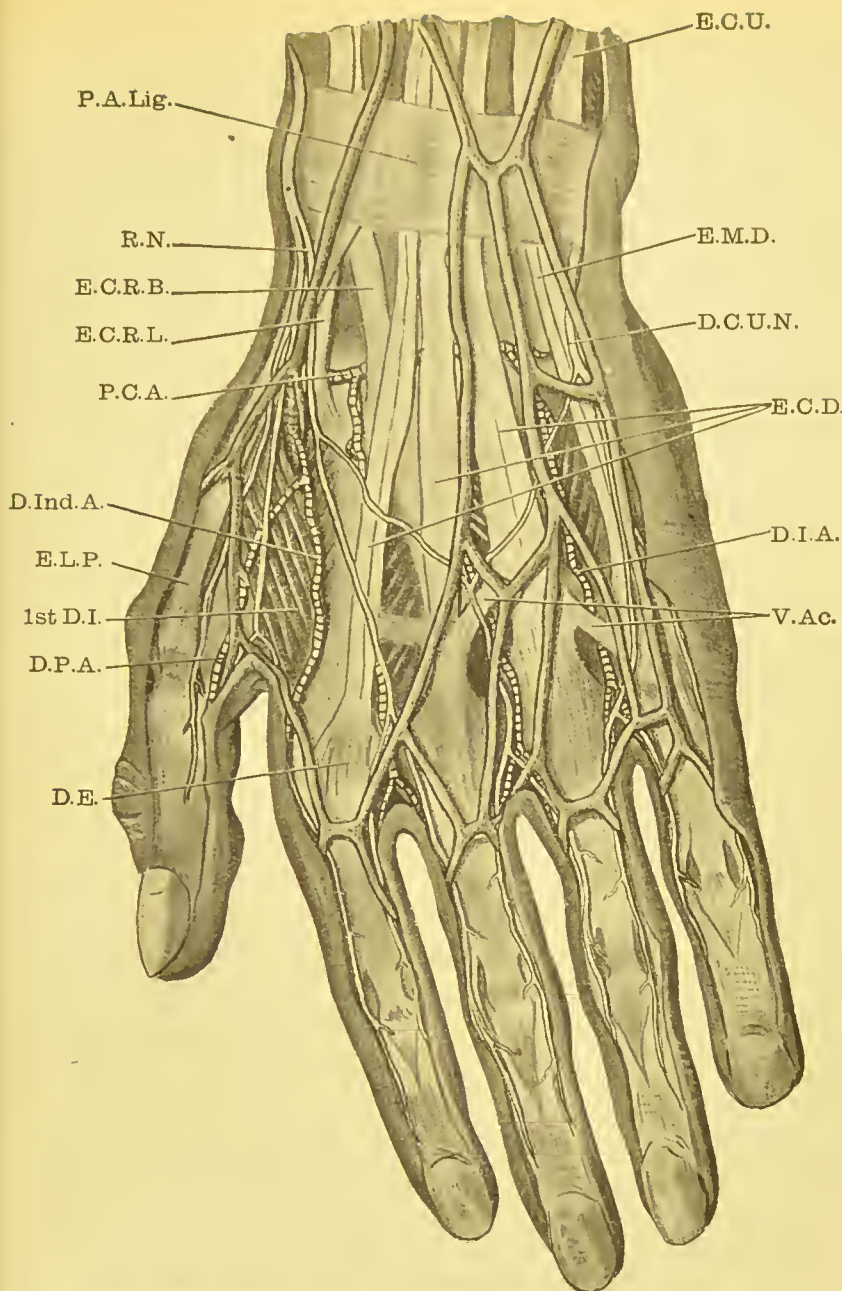


FIG. 326.—DISSECTION OF THE DORSUM OF THE HAND.

E.C.U. Extensor Carpi Ulnaris. *E.M.D.* Extensor Minimi Digiti. *D.C.U.N.* Dorsal Cutaneous Branch of the Ulnar Nerve. *E.C.D.* Extensor Communis Digitorum. *D.I.A.* Dorsal Interosseous Artery. *V.Ac.* Vincula Accessoria. *D.E.* Dorsal Expansion of Extensor Tendon. *D.P.A.* Dorsalis Pollicis Artery. *1st D.I.* First Dorsal Interosseus Muscle. *E.L.P.* Extensor Longus Pollicis. *D.Ind.A.* Dorsalis Indicis Artery. *P.C.A.* Posterior Carpal Arch. *E.C.R.L.* Extensor Carpi Radialis Longior. *E.C.R.B.* Extensor Carpi Radialis Brevior. *R.N.* Radial Nerve. *P.A.Lig.* Posterior Annular Ligament.

the extensor longus pollicis and the extensor indicis muscles, but in doing so be very careful not to injure the slender continuation of the posterior interosseous nerve, which sinks to a deeper plane between the neighbouring edges of the extensor brevis and extensor longus pollicis, and so reaches the posterior surface of the interosseous membrane. After this the anterior interosseous artery and the posterior interosseous nerve may be traced down together until the *posterior carpal arch* [arcus carpeus dorsalis] is reached. This is a delicate arterial arch, lying on the dorsal surface of the distal row of carpal bones, and deep to all the tendons; it is formed by the posterior carpal branches of the radial and ulnar arteries, and is usually joined, deep to the tendon of the extensor indicis, by what little there is left of the posterior branch of the anterior interosseous artery.

From this posterior carpal arch small *dorsal interosseous arteries* [aa. metacarpeæ dorsales] run towards the clefts of the fingers, sometimes in the three ulnar intermetacarpal spaces, sometimes only in the ulnar two; but they are reinforced substantially by the perforating branches of the deep palmar arch already referred to. When the heads of the metacarpal bones are reached, these arteries divide for the adjacent sides of two fingers; but by the time the joints between the proximal and middle phalanges are reached, they usually anastomose with the arteries coming from the palmar sides of the digits.

As these various arterial arches and their branches are easily confused, the accompanying diagram may prove useful (Fig. 327).

Now follow the posterior interosseous nerve to its ending, in a small gangliform enlargement on the dorsum of the carpus, deep to the tendon of the extensor indicis.

The *second part of the radial artery* (or stage in the wrist) must now be dissected. The first part or stage in the forearm (see p. 300) was followed down to the outer side of the tendon of the flexor carpi radialis on a level with

the styloid process of the radius. Here the second part begins, and the artery now runs backwards and downwards deep to the tendons of the extensor ossis metacarpi and extensor brevis pollicis. In doing so it has entered the "anatomical snuff-box" already noticed. Cut and reflect these two tendons, and notice that the artery is now curving round the outer side and back of the trapezium. Especially notice how close it is to the carpo-metacarpal joint of the thumb, and how carefully it must be avoided in amputation at this joint. The radial vein and nerve, which here lie

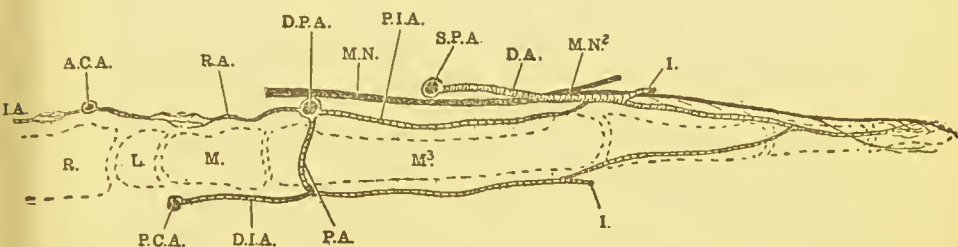


FIG. 327.—SCHEME OF THE ARTERIES OF THE HAND.

R. Radius. *L.* Semilunar Bone. *M.* Os Magnum. *M*³. Third Metacarpal Bone. *A.I.A.* Anterior Interosseus Artery. *A.C.A.* Anterior Carpal Arch. *R.A.* Recurrent Artery. *D.P.A.* Deep Palmar Arch. *M.N.* Median Nerve. *P.I.A.* Palmar Interosseous Artery. *S.P.A.* Superficial Palmar Arch. *D.A.* Digital Artery. *M.N*². Median Nerve becoming Superficial. *I.* Branch to adjoining Finger. *P.C.A.* Posterior Carpal Arch. *D.I.A.* Dorsal Interosseous Artery. *P.A.* Perforating Artery.

superficial to it, have already been seen, and may be cleared away.

Replace the tendon of the extensor longus pollicis in its groove, and notice that, immediately after passing deep to it, the artery pierces the origin of the first dorsal interosseous muscle between the bases of the first two metacarpal bones.

Bearing these points in mind, the surface markings of this part of the artery are easily worked out. Take a point on the outer side of the flexor carpi radialis tendon at the level of the tip of the styloid process of the radius, then feel for the bases of the first and second metacarpal bones just

below the point where the extensor longus pollicis crosses them, and join the two points.

BRANCHES OF THE SECOND PART OF THE RADIAL ARTERY

The *posterior* or *dorsal radial carpal* [ramus carpeus dorsalis] is usually the first branch; it completes the posterior carpal arch already studied.

The *first dorsal interosseous artery* [a. metacarpea dorsalis prima], which, it must be borne in mind, supplies the second interosseous space, is sometimes a separate branch of the radial, but more often rises in common with the posterior carpal.

Arteria dorsalis pollicis.—One or two small twigs to the back of the thumb.

Arteria dorsalis indicis.—A branch which runs along the radial side of the metacarpal bone of the index finger. None of these branches are of any real importance, though a knowledge of them is sometimes required for examination purposes.

The following epitome of the branches of the radial artery may be found useful. There are usually four branches from each of the three stages:—

In the Forearm

- (1) Radial recurrent.
- (2) Muscular.
- (3) Superficial volar.
- (4) Anterior carpal.

In the Wrist

- (1) Dorsal carpal.
- (2) First dorsal interosseous.
- (3) Dorsalis pollicis.
- (4) Dorsalis indicis.

In the Hand

- (1) *Princeps pollicis*.
- (2) *Radialis indicis*.
- (3) *Palmar interosscous*.
- (4) *Perforating*.

It will further be noticed that, if the term dorsal carpal be substituted for posterior carpal, all the branches of the stage in the wrist have "dorsal" in their names.

THE JOINTS OF THE UPPER EXTREMITY

After clearing away as much tissue as can be done without approaching the joints too closely, the extremity will generally be the better for a night's soaking in cold water.

The sterno-clavicular articulation has been examined by the dissectors of the head and neck (see p. 154, vol. i.), so that the first joint to take in hand is the ACROMIO-CLAVICULAR ARTICULATION. This is an arthrodial or gliding variety of the movable joints. The bones are held together by a capsule, the superior ligament of which is stronger than the inferior. Notice that slight gliding of the bony surfaces takes place both upwards and downwards and forwards and backwards.

Hold the clavicle as far away from the joint as possible and let the whole arm hang from it, then swing it gently backwards and forwards, when the arm and scapula will be seen to swing like a pendulum from the clavicle; that is to say, a rotation round the long axis of the clavicle is possible, in addition to the gliding movement.

The acromio-clavicular articulation is obviously too feeble to support the weight of the arm, and in holding it up by the clavicle the scapula is seen to hang from the former bone by two strong ligaments, the *coraco-clavicular*, which, although they are more than an inch away from the joint, are most

important in keeping the bony ends in apposition; the posterior of these two ligaments is called the *conoid*, and is an inverted cone attached above to the conoid tubercle of the clavicle, and below to the bend or knuckle of the coracoid process, while the anterior ligament, the *trapezoid*, is attached to the trapezoid ridge on the under surface of the clavicle and upper surface of the coracoid process.

Cut through the upper ligament of the acromio-clavicular joint and look for an incomplete meniscus or interarticular fibro-cartilage [*discus articularis*] hanging down from it for a short distance. Notice also that the clavicle overrides the acromion somewhat, so that when this joint is dislocated the clavicle is almost always displaced upward.

The *coraco-acromial ligament* is triangular, the base being attached to the posterior border of the coracoid process, while the apex joins the tip of the acromion process. The central part of this ligament is usually more feeble than its margins; it is sometimes even perforated. Beneath this ligament is the large subacromial bursa already explored. Below this again, and separating it from the capsule of the shoulder, is the supra-spinatus muscle. When the body is supported by the arms, as in parallel-bar exercises, the weight is taken by the acromion and coraco-acromial ligament, and the bursa plays the part of an accessory shoulder joint. If it were not for this overhanging arch, upward dislocation of the shoulder would constantly happen.

THE SHOULDER JOINT [*articulatio humeri*].—Clear away the supra-spinatus, infra-spinatus, teres minor, and subscapularis as far as possible without opening the joint. When the capsule is fully exposed, notice that its laxity is great enough to allow the head of the humerus to be drawn away from the glenoid cavity for nearly an inch. Trace the attachment of the capsule round the margin of the glenoid cavity, on the one hand, and round the anatomical neck of the humerus on the other. Notice that the capsule is continued down as a roof to the bicipital groove for some

distance, and look for a possible gap in the front, where the bursa, deep to the subscapularis, communicates with the

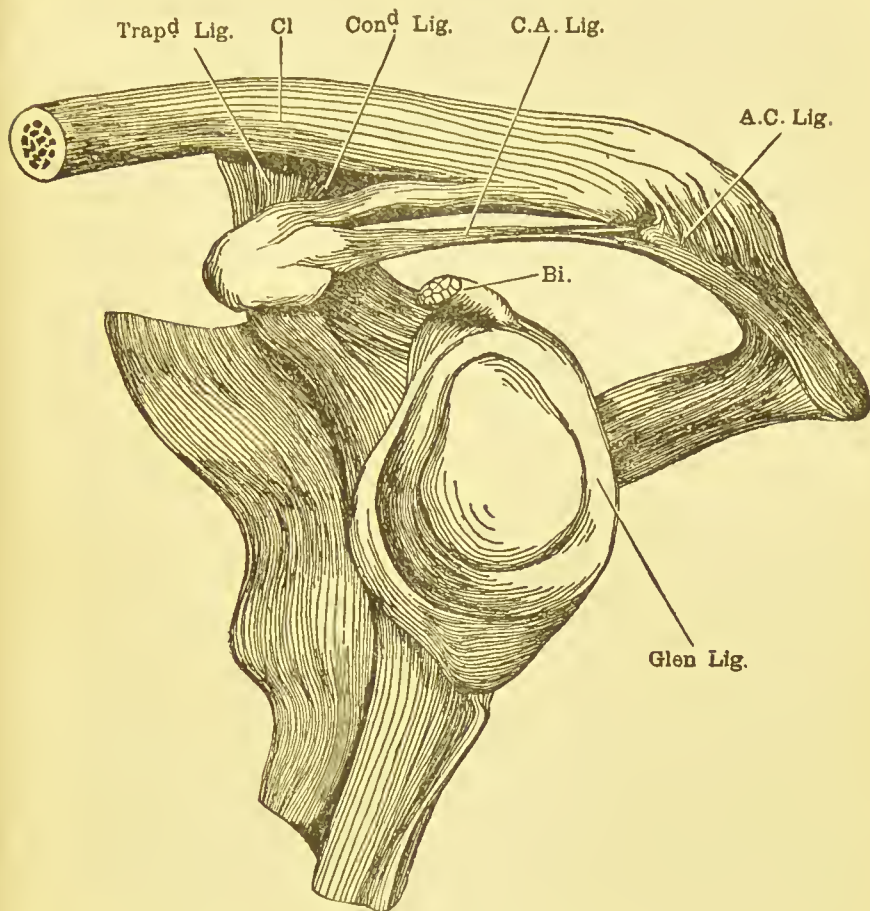


FIG. 328.—CORACO-CLAVICULAR, ACROMIO-CLAVICULAR, AND GLENOID CAVITY OF THE SHOULDER JOINT.

Trapd.Lig. Trapezoid Ligament. *Cl.* Clavicle. *Con^d.Lig.* Conoid Ligament. *C.A.Lig.* Coraco-acromial Ligament. *A.C.Lig.* Acromio-clavicular Capsule. *Bi.* Long Head of Biceps. *Glen.Lig.* Glenoid Lip.

synovial membrane. There is only one thickening of the capsule; this extends up the nearest border of the coracoid process (the outer) and strengthens the upper and front part.

When the arm is hanging by the side, it supports the weight of all the parts below the shoulder.

The actions of the joint have been discussed already (see p. 249), and they should now be reviewed. It is quite evident that we are here dealing with a very movable joint; indeed, it is the most movable in the whole body; it therefore, like all the joints of the upper extremity, belongs to the diar-

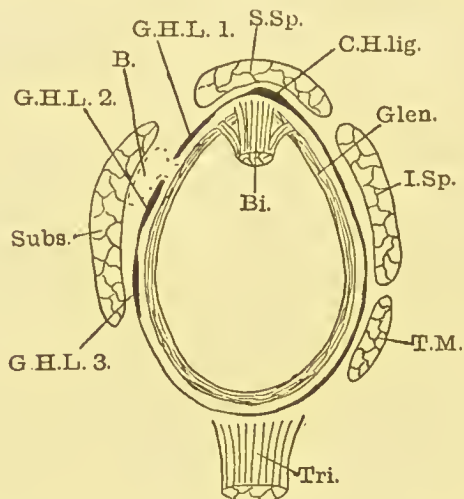


FIG. 329.—DIAGRAMMATIC SECTION THROUGH THE CAPSULE OF THE SHOULDER JOINT SHOWING THE MUSCLES IN RELATION TO IT.

S.Sp. Supra-spinatus. *C.H.Lig.* Coraco-humeral Ligament. *Glen.* Glenoid Lip. *I.Sp.* Infra-spinatus. *T.M.* Teres Minor. *Tri.* Long Head of Triceps. *G.H.L. 1, 2, and 3.* The three Gleno-humeral Ligaments. *Subs.* Subscapularis. *B.* Its Bursa communicating with the Joint. *Bi.* Biceps.

throres or diarthrodial joints (from the Greek *διά*, through or thorough = thoroughly movable joints).

It is also one of the particular kinds of diarthrodial joints known as ball and socket or enarthrodial, so that its full description is an enarthrodial diarthrosis. Open the joint from behind, and notice the tendon of the biceps, surrounded by synovial membrane, lying free in the joint cavity. Notice, too, the *glenoid lip* or *ligament* [labrum glenoidale], a rim of

fibro-cartilage which deepens the glenoid cavity, and is also intra-capsular.

On the anterior wall of the capsule; when looked at from behind, one, two, or three delicate ridges of synovial membrane may be seen; these are the gleno-humeral ligaments, but, although of a good deal of morphological interest, they are of no practical importance (see Fig. 329).

THE ELBOW JOINT [articulatio eubiti].—In this joint the upper ends of the radius and ulna are attached to the lower end of the humerus by a capsule, the upper attachment of which may be marked out on a dry humerus by drawing a line from the lower part of the internal condyle, round the front of the bone just above the coronoid and radial depressions, to the lower part of the external condyle. Then round the back of the bone above the olecranon depression to the starting-point.

Below, the line of its attachment is to the upper surface of the olecranon, a little behind its free anterior border, to the inner side of this process, and then, by means of a bridge-like band, to the inner side of the coronoid process; it then passes round the front of the coronoid, a little below the free anterior border, to the front of the lesser sigmoid cavity. It is not directly attached to the radius, but to the *orbicular ligament* [lig. annulare radii], which forms a strap round the disc-shaped head of that bone, and with the lesser sigmoid cavity forms a circular socket in which the head of the radius can rotate.

Strictly speaking, this orbicular ligament does not belong to the elbow joint, but to the SUPERIOR RADIO-ULNAR ARTICULATION [articulatio radio-ulnaris proximalis]; but, since the cavities of the two joints are continuous, they must be examined together.

It is usual to describe anterior and posterior as well as internal and external lateral ligaments to the elbow, but they are all parts of one capsule. Before opening the joint, notice its movements; these are practically only flexion and exten-

sion, the former limited by the soft parts of the arm and forearm coming into contact, the latter by the olecranon process fitting into its fossa, and the tension of the anterior ligament.

The elbow, therefore, is a hinge joint or ginglymus, another variety of the diarthroses.

Open the joint by a bold horizontal sweep of the knife round the front of the capsule, dividing the anterior and two lateral parts. Notice that the internal lateral ligament [lig. collaterale ulnare] has two bands or thickenings, one running from the internal condyle to the coronoid process, the other to the olecranon. The single thickening of the external lateral ligament [lig. collaterale radiale] blends below with the orbicular ligament.

It will be seen that the synovial membrane does not line the capsule quite closely in all parts; opposite the three fossæ of the humerus little wedge-shaped pads of fat separate the two structures and fill the depressions when they are not occupied by the bones which fit into them. Other pads are seen on each side of the front of the root of the olecranon process, as well as on the external part of the capsule between the head of the radius and the capitellum.

Notice that the cavity of the elbow joint is continuous with that of the superior radio-ulnar joint. This is really important, since any trouble affecting the one is likely to spread to the other.

Pass a fine seeker down between the orbicular ligament and the head of the radius, and notice that the ligament is attached to the neck of the bone by a thin but lax membrane. The movements of this joint are best studied with those of the other radio-ulnar articulations.

The MIDDLE RADIO-ULNAR ARTICULATION consists of the interosseous membrane and the oblique ligament.

The *interosseous membrane* has fibres which run downwards and inwards from the interosseous border of the radius

to that of the ulna. The *oblique ligament* [chorda obliqua] runs in the opposite direction, downwards and outwards from

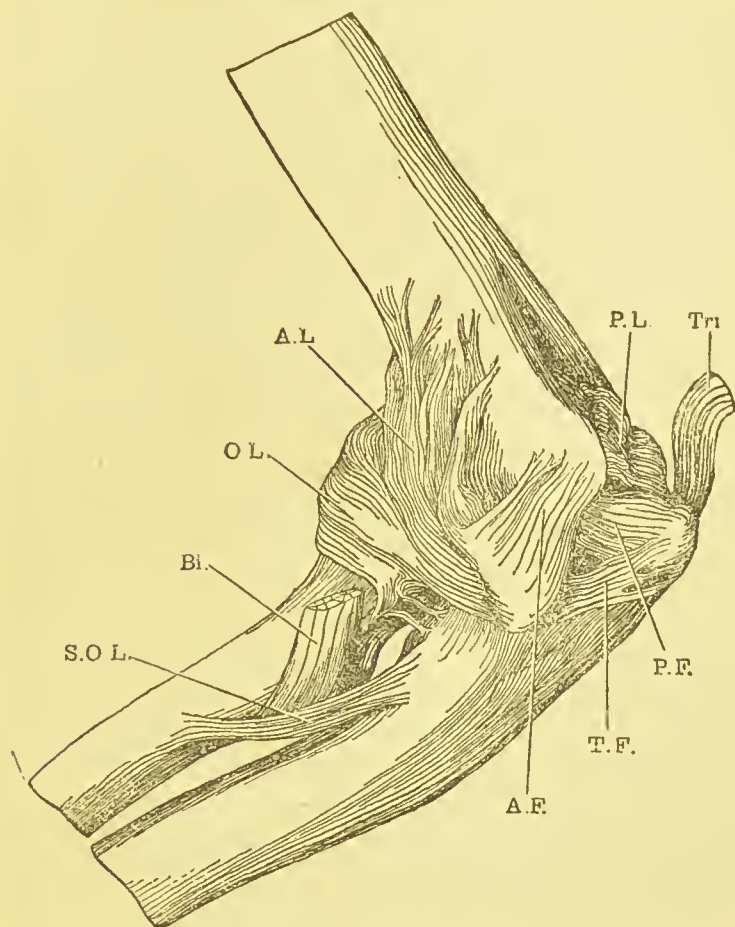


FIG. 330.—THE ELBOW AND SUPERIOR RADIO-ULNAR JOINTS SEEN FROM THE INNER (MEDIAL) SIDE.

A.L. Anterior Ligament of Elbow. *P.L.* Posterior Ligament of Elbow. *O.L.* Orbicular Ligament. *Bi.* Insertion of Biceps. *S.O.L.* Superior Oblique Ligament. *A.F.*, *T.F.*, *P.F.* Anterior, Transverse, and Posterior Fasciculi of the Internal Lateral Ligament. *Tri.* Triceps.

the lower part of the front of the coronoid process to just below the tubercle of the radius. Its attachments are easily borne in mind when it is realised that it runs from below the

insertion of one big flexor of the forearm (brachialis anticus) to below the insertion of the other (biceps).

- When two bones are attached by fibrous tissue, as these are, in such a way as to leave plenty of movement between them, the free fibrous union is spoken of as a *syndesmosis*.

The INFERIOR RADIO-ULNAR JOINT [articulatio radio-ulnaris distalis] lies between the sigmoid cavity of the radius and the margin of the lower end of the ulna. The bones are bound together by anterior and posterior ligaments as well as by a triangular fibro-cartilage which cannot be seen at present.

Now study the MOVEMENTS OF THE THREE RADIO-ULNAR ARTICULATIONS. Imagine a long steel rod passed through the centre of the disc-shaped head of the radius, down through the neck and out of the bone just below the tubercle, then obliquely through the lower end of the ulna to emerge just external to the root of the styloid process. This would represent the axis round which the radius moves. Place the forearm in the anatomical or supine position with the palm forwards, then twist it round till the palm looks backwards. This is pronation, and in it the ulna does not move at all, but the head of the radius twists round its centre in the circle formed by the orbicular ligament and lesser sigmoid cavity of the ulna. The lower end of the radius, on the other hand, describes a semicircle round the lower end of the ulna, the centre of which is the base of the styloid process of the ulna. Supination is exactly the reverse action to pronation.

In the living body it is true the palm can be made to describe a complete circle, but half of this occurs at the shoulder joint.

A joint which acts round only one axis is a hinge or ginglymus, and when the axis is vertical the term *lateral ginglymus* or *trochoid joint* is applied to it; consequently both the superior and inferior radio-ulnar articulations are trochoid joints, though in the former the radius twists round its own axis, while in the latter it uses the lower end of the ulna as its pivot or axis. It will be seen that in its pronation

and supination the radius describes half a cone, the apex of which is above and the base below.

Now cut the orbicular ligament, and free it from the neck of the radius; cut the oblique ligament and interosseous membrane, and draw the upper end of the radius away from the ulna gently. It will now be noticed that the synovial membrane of the inferior radio-ulnar joint rises some little distance between the bones; it is called *membrana sacciformis* [recessus saeeiformis]. Now cut the anterior and posterior ligaments of this joint, after which the ulna can be turned aside enough to give a good view of the *triangular fibro-cartilage* [diseus articularis], which in most cases completely separates the inferior radio-ulnar joint from the wrist. Its apex is seen to be attached close to the root of the styloid process of the ulna, its base to the border of the radius which separates the sigmoid cavity from the articular surface for the wrist, while anteriorly and posteriorly it blends with the capsule.

Notice that this meniscus is thinnest about its middle, and here it is sometimes perforated. When this is the case, the wrist and inferior radio-ulnar joints communicate.

The WRIST JOINT [articulatio radio-carpea] lies between the radius and triangular fibro-cartilage above and the scaphoid, semilunar and cuneiform bones below. It has a complete capsule of great strength. Notice that when the fibres of the front or back of this capsule are cleaned with a sharp knife—and for dissecting ligaments a knife with a very sharp point is needed—the fibres run downwards and inwards from the radius to the first row of carpal bones.

In studying the action of the wrist the first row of carpal bones should be grasped firmly, or else the wrist joint will be given credit for movements which really happen between the proximal and distal rows of carpal bones.

The living hand can be bent to a right angle with the forearm, but the dissected joint will show that less than 45° of this flexion really occurs at the wrist. Extension is rather

less limited than flexion. In these two movements the joint has been acting like a hinge round a nearly transverse axis,

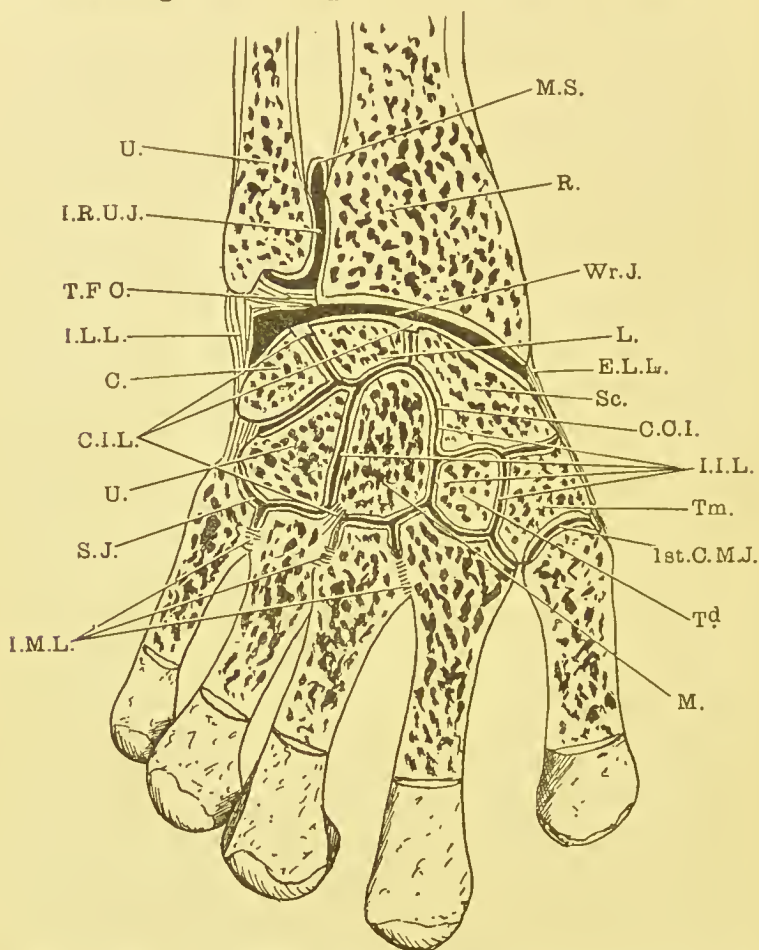


FIG. 331.—SECTION OF THE CARPUS TO SHOW THE WRIST, INTERCARPAL AND CARPO-METACARPAL JOINTS.

U. Ulna. *R.* Radius. *I.R.U.J.* Inferior Radio-ulnar Joint. *M.S.* Membrana Sacciformis. *T.F.C.* Triangular Fibro-cartilage. *Wr.J.* Wrist Joint. *I.L.L.* Internal Lateral Ligament of Wrist. *E.L.L.* External Lateral Ligament of Wrist. *Sc.* Scaphoid. *L.* Semilunar. *C.* Cuneiform. *C.I.L.* Complete Intercarpal Ligaments. *I.I.L.* Sites of Incomplete Intercarpal Ligaments. *Tm.* Trapezium. *Td.* Trapezoid. *M.* Os Magnum. *U.* Unciform. *C.C.J.* Common Carpal Joint. *1st.C.M.J.* First Carpo-metacarpal Joint. *S.J.* Separate Carpo-metacarpal Joint for the two Ulnar Digits. *I.M.L.* Inter-metacarpal Ligaments.

but it can also act round an antero-posterior axis and produce the movements of adduction and abduction. Adduction is very free, and the living hand can be adducted to a right angle with the forearm, though here again the intercarpal joints are responsible for a good deal of the movement. Abduction, however, is very slight, and the hand can only be abducted through a very few degrees from the straight line of the radius.

Notice that no rotation round a vertical axis is allowed, nor is any needed, since pronation and supination of the forearm supply this movement. The wrist is known as a condyloid joint; that is to say, it is a ball-and-socket joint as far as its bony surfaces are concerned, and as far as its movements are concerned, except that it can only act round two axes; it lacks rotation. Open the joint from the front and notice that the three bones of the carpus which enter into it are joined together by two *interosseous ligaments* [ligg. intercarpea interossea]. These are complete; that is to say, they reach from the palmar to the dorsal aspect of the joint, and so there is never any communication between the wrist and the intercarpal articulations.

THE CARPAL JOINTS [articulatio intercarpea]. — First examine the joint between the pisiform and cuneiform bones [articulatio ossis pisiformis]; this has a capsule which shuts it off completely from all the other articulations. There are two accessory bundles of fibres, without which this capsule would be much too weak for its duties. The first runs up to the styloid process of the ulna, and is formed by the anterior fibres of the internal lateral ligament of the wrist; while the second (pisi-unciform ligament) runs down to the hook of the unciform and resists the pull of the flexor carpi ulnaris muscle. This, like all the other intercarpal joints, belongs to the gliding or arthrodial variety.

The carpal bones other than the pisiform are connected by palmar, dorsal, and interosseous ligaments. The palmar and dorsal ligaments take a good deal of time and patience


to display properly, since the intervals between any two adjacent ligaments is filled up with less dense fibrous tissue; it would therefore be quite a satisfactory and practical thing to think of all the intercarpal joints as having a continuous palmar and dorsal capsule, blending with the periosteum of the bones, and strengthened in various places by special palmar and dorsal bands.

On the palmar side these bands form a star radiating from the os magnum [lig. carpi radiatum], while on the dorsum they are less regular, but there is one special band passing from the scaphoid to the euneiform behind the head of the os magnum; this is known as the *dorsal transverse ligament of the carpus*, and prevents the head of the os magnum starting back.

To find the interosseous ligaments the joints must be opened, but before this is done, notice how the various carpal bones glide on one another in different movements of the hand, and how the *transverse carpal joint* between the proximal and distal row of carpal bones reinforces the movements of the wrist joint.

It will be found to allow rather more extension than the wrist does, but rather less flexion. The wrist, it will be remembered, allows more flexion than extension.

Very little abduction or adduction is obtained at the transverse carpal joint, but there is a certain amount. Some authors neglect this and call the joint a hinge; others think it worthy of notice, in which case the joint is condyloid.

Now open the transverse carpal joint from in front, and notice its sinuous line like an S laid on its back, thus, .

The interosseous carpal ligaments should now be looked for by separating the various bones gently. There are none between the bones of the proximal and distal rows; the two joining the bones of the proximal row are complete, and have already been seen from the wrist, while the four bones of the

distal row are united by three ligaments which are usually incomplete, so that the articular cavity of the carpo-metacarpal joint communicates with that of the intercarpal.

The CARPO-METACARPAL JOINT OF THE FOUR FINGERS, like the intercarpal, has palmar, dorsal, and interosseous ligaments; the palmar and dorsal may be dissected out if time permits, but their exact arrangement is somewhat variable and not of any practical importance. Before cutting any ligaments make out the movements; these are very slight, and consist of feeble flexion and extension, though these are a good deal more free in the joint between the unciform and the little finger. Abduction is very limited, but still is extensive enough to burst a tight dress glove occasionally. Such feeble movements are nothing more than gliding, so that this is classed among the arthrodial joints.

Open the joint from in front, and notice that there are two interosseous ligaments. The outer one joins the outer side of the base of the index metacarpal to the trapezium and is always complete, so that the carpo-metacarpal joint of the thumb never communicates with that of the other digits.

The inner interosseous ligament joins the contiguous borders of the medius and annularis metacarpals to the borders of the os magnum and unciform. It is sometimes complete, and when this is the case the carpo-metacarpal joints of the annularis and minimus digits are shut off from the common joint cavity.

The CARPO-METACARPAL JOINT OF THE THUMB is remarkable for the saddle-shaped appearance of both its articular surfaces, the concavity of one fitting into the convexity of the other, and *vice versa*. Like the condyloid joints, it will be found to allow movements round two axes—abduction and adduction as well as flexion and extension—but no rotation; it is, however, less liable to dislocation than is the condyloid joint. It has a complete capsule, which should be opened to examine the joint surfaces of the

trapezium and pollex metacarpal bones. This is the only example in the body of the saddle-shaped joint.

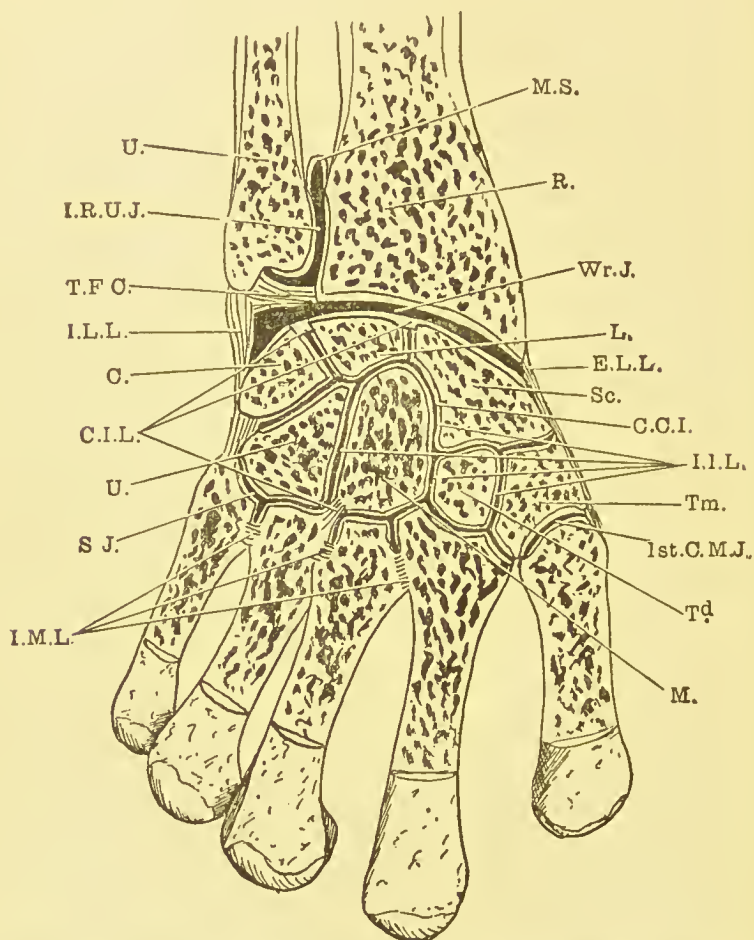


FIG. 332.—SECTION OF THE CARPUS TO SHOW THE WRIST, INTERCARPAL, AND CARPO-METACARPAL JOINTS.

U. Ulna. *R.* Radius. *I.R.U.J.* Inferior Radio-ulnar Joint. *M.S.* Membrana Sacciformis. *T.F.C.* Triangular Fibro-cartilage. *Wr.J.* Wrist Joint. *I.L.L.* Internal Lateral Ligament of Wrist. *E.L.L.* External Lateral Ligament of Wrist. *Sc.* Scaphoid. *L.* Semilunar. *C.* Cuneiform. *C.I.L.* Complete Intercarpal Ligaments. *I.I.L.* Sites of Incomplete Intercarpal Ligament. *Tm.* Trapezium. *T^d* Trapezoid. *M.* Os Magnum. *U.* Unciform. *C.C.I.* Common Carpal Joint. *1st C.M.J.* First Carpo-metacarpal Joint. *S.J.* Separate Carpo-metacarpal Joint for the two Ulnar Digits. *I.M.L.* Inter-metacarpal Ligaments.

The INTER-METACARPAL JOINTS lie between the bases of the four inner metacarpal bones, and the articular cavities are continuous with the carpo-metacarpal. All four bones are joined together by palmar, dorsal, and very strong interosseous ligaments. Notice on opening these joints that they only extend a very little distance between the bases of the metacarpal bones.

The various articular cavities in relation to the carpal bones should now be revised. They are:—

(1) The Inferior Radio-ulnar Cavity, usually completely shut off by the triangular fibro-cartilage.

(2) The Wrist Joint, always shut off by the interosseous ligaments between the bones of the proximal carpal row.

(3) The Cuneo-pisiform Articulation, always shut off from the rest.

(4) The Common Central Joint Cavity, which includes the intercarpal, some of the carpo-metacarpal, and the inter-metacarpal joints.

(5) The Carpo-metacarpal Joint of the Thumb, always completely shut off.

(6) The Carpo-metacarpal Joint cavity for the two inner digits. This may or may not be a separate cavity from the common carpal sac.

The METACARPO-PHALANGEAL JOINTS OF THE FOUR INNER FINGERS have a complete capsule, of which the palmar ligament is very thick for some distance above the base of the phalanx, though where it is attached to the metacarpal bone it is quite thin. Take a fine, sharp saw and make a median sagittal section right down one of the fingers; where this passes through the metacarpo-phalangeal joint the difference between the thick and thin parts of the palmar ligament will be easily seen. The thick part is called the *glenoid ligament* [lig. accessorium volare], and indeed recalls the glenoid ligament of the shoulder, since it is made of fibro-cartilage and serves to deepen the socket for the head of the metacarpal bone. It differs, however, from its namesake of the shoulder

in not being intraeapsular. When the finger is flexed the glenoid ligament slides in front of the head of the metacarpal, puckering very little, whereas the rest of the palmar ligament puckers very much. It has already been seen that the four glenoid ligaments are connected by the deep transverse metacarpal ligaments [ligg. capitulorum transversa]. The dorsal part of the capsule is very thin, while the lateral ligaments [ligg. collateralia] are strong and fan-shaped, the apex of the fan being attached to the side of the head of the metacarpal bone palmar to the tubercle.

Move the fingers of your own hand, and notice that these joints are typically condyloid, allowing flexion, extension, abduction and adduction. Extension, as a rule, cannot be carried beyond a straight line with the hand unless the fingers are forcibly pulled back. This is sometimes known as hyper-extension, and varies in degree in different people; it is generally more free in the index and minimus.

The METACARPO-PHALANGEAL JOINT OF THE THUMB differs from the foregoing in having two sesamoid bones embedded in the glenoid ligament; there is also so little lateral movement that it is almost a hinge. The amount of flexion varies in different individuals, some being able to flex this joint to a right angle, others only to 20° .

The double-jointed thumb, which is fairly common, is a subluxation backward apparently connected with lax lateral ligaments, though we are not aware that the opportunity has ever occurred of dissecting a specimen.

The INTERPHALANGEAL JOINTS closely resemble the metacarpo-phalangeal except in their trochlear joint surfaces and the absence of any lateral movement. They have a glenoid palmar ligament, an almost negligible dorsal, and very strong lateral ligaments. They are perhaps the most perfect hinge joints in the body.

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